Draft Environmental Impact Statement

Noranda Minerals Corp.

MONTANORE PROJECT

PREPARED BY:

U.S. Forest Service

Montana Department of State Lands

Montana Department of Health and Environmental Sciences

Montana Department of Natural Resources & Conservation

Draft
Environmental Impact Statement

NORANDA MINERALS CORPORATION
MONTANA RESERVES COMPANY
JOINT VENTURE

MONTANORE PROJECT

October, 1990

U. S. Forest Service
Kootenai National Forest

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COVER SHEET

Type of Statement

Draft Environmental Impact Statement

Proposed Action

Construction and operation of the Montanore Project

Lead Agencies

Kootenai National Forest
Montana Department of State Lands
Montana Department of Natural Resources and Conservation
Montana Department of Health and Environmental Sciences

Cooperating Agencies

U.S. Fish and Wildlife Service
State Historic Preservation Office
Hard Rock Mining Impact Board
U.S. Army Corps of Engineers
Bonneville Power Administration

Abstract

The Montanore Project Draft Environmental Impact Statement describes the land, the people and the resources potentially affected by the proposed Montanore Project. The major federal and state action consists of the approval of all necessary permits to construct and operate the Montanore Project. The proposed project would consist of six primary components: an underground mine, a mill, two adits and portals, a tailings impoundment, access roads, and a 16.3-mile electric transmission line. Seven alternatives analyzed in detail in this draft EIS include the proposed action, mitigation of mine-related impacts, mitigation of transmission line-related impacts, alternative water treatment, North Miller Creek alternative transmission line routing, Swamp Creek alternative transmission line routing, and no action.

Comment Period

This is a draft Environmental Impact Statement open to public comment and review for 60 days following publication, on October 10, 1990, of the Notice of Availability in the *Federal Register*. Comments should be directed to Ron Erickson, Kootenai National Forest, at the address below. A public meeting will be held in Libby, Montana on October 24, 1990.

For further information, please contact

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CONTENTS

Chapter 3—The Affected Environment

Chapter 4—Consequences of the Proposal and Alternatives

Chapter 5—Comparison of Alternatives

Chapter 6—Methods

Chapter 7—Consultation and Coordination

Appendix B—Monitoring Programs

Tables

Chapter 4

Figures

SUMMARY

THIS document summarizes the information contained in the Draft Environmental Impact Statement (draft EIS) for the proposed Montanore Project. As a summary, this document cannot provide all the detailed information contained in the draft EIS. If one is interested in more detailed information, the draft EIS should be reviewed. It can be obtained by contacting one of the following people—

Ron Erickson
Kootenai National Forest
506 Highway 2 West
Libby, MT 59923

Sandi Olsen
Montana Department of State Lands
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A copy of the EIS can be reviewed at the following locations—

Northern Regional Office, U.S. Forest Service, Missoula, Montana

Supervisor's Office, Kootenai National Forest, Libby, MT

Cabinet Ranger Station, Trout Creek, MT

Libby Ranger Station, Libby, MT

Montana Department of State Lands, Helena, MT

Montana Department of Health and Environmental Sciences, Helena, MT

Montana Department of Natural Resources and Conservation, Helena, MT

Lincoln County Library, Libby, MT

Missoula City-County Library, Missoula, MT

The Montanore Project consists of an underground copper and silver mine, a mill to process ore, a tailings impoundment, water disposal areas, access roads, and a 16-mile electrical power transmission line to the project site. The project is a joint venture between Noranda Minerals Corporation (Noranda) and Montana Reserves Company. Noranda would be the project operator. The mine and mill would be located in Lincoln County, about 18 miles south of Libby, Montana (Figure S-1).

The Montanore Project has been reviewed jointly by state and federal agencies with permitting responsibilities for the project. The results of this analysis are documented in this joint draft EIS. An EIS is a public document disclosing the environmental consequences of a proposed action and alternatives to that action. An EIS is required where a proposed action by Montana or a Federal agency may "significantly affect the quality of the human environment." Statutory requirements concerning preparation of EISs are described in the National Environmental Policy Act (NEPA), the Montana Environmental Policy Act (MEPA) and the Montana Major Facility Siting Act (MFSA). In preparing this draft EIS the agencies have solicited input from governmental agencies and the public. A final EIS will be prepared after additional opportunity for governmental agencies and public review and comment on the draft EIS.

THE EIS AND PERMITTING PROCESS FOR THE MONTANORE PROJECT

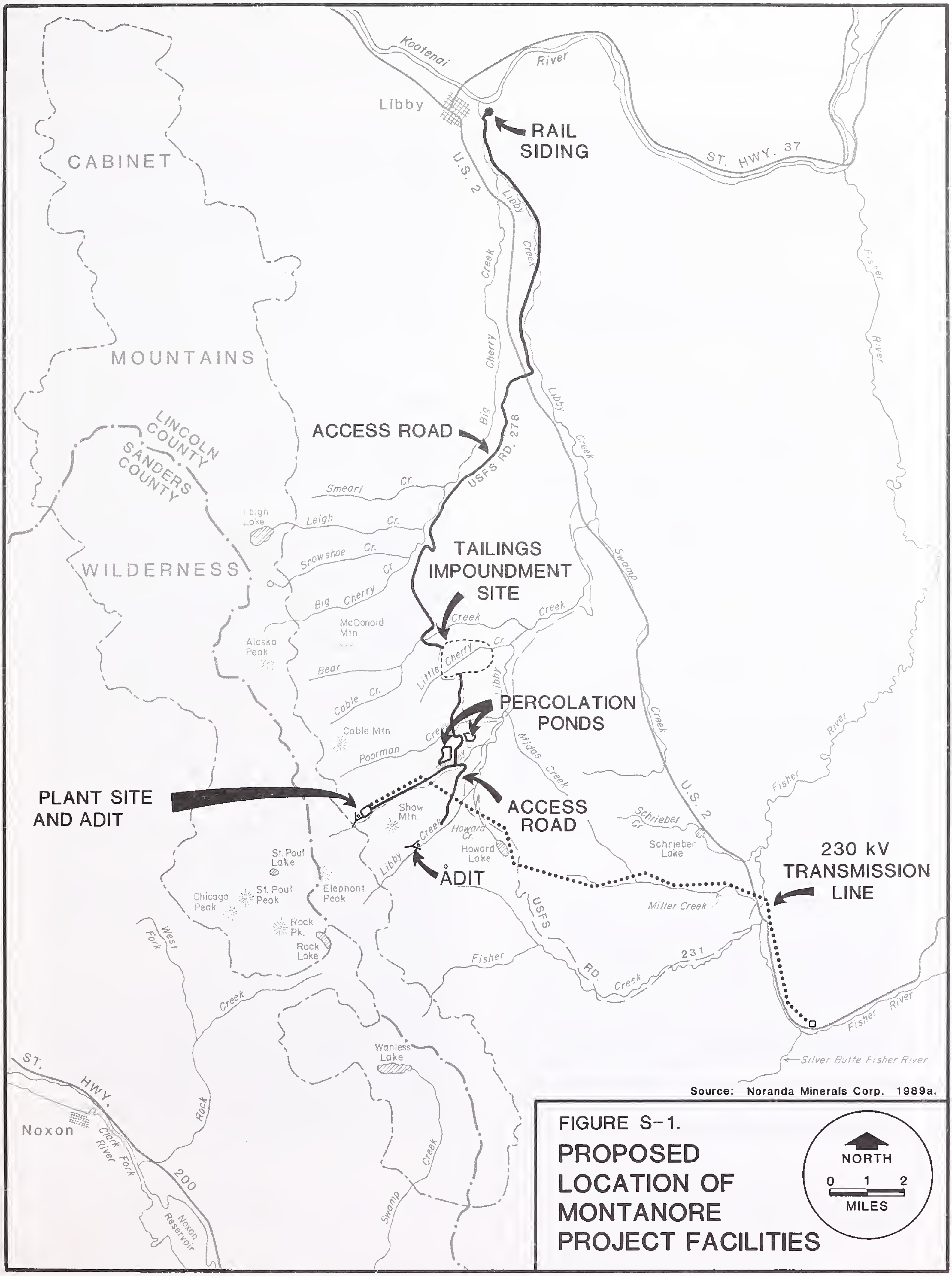
Four governmental agencies serve as "lead" agencies for this EIS. The environmental analysis documented in the draft EIS was initiated in response to applications to operate the Montanore Project submitted to the Montana Department of State Lands (DSL), the Kootenai National Forest (KNF), and the Montana Department of Natural Resources and Conservation (DNRC). The Montana Department of Health and Environmental Sciences (DHES) became the fourth lead agency in response to Noranda's petition for Change in Ambient Water Quality.

The scope of this draft EIS includes actions, alternatives, and analyses that would be considered in separate EISs required by each agency in order to fulfill their regulatory responsibilities. Preparation of a single draft EIS for the Montanore Project provides a more coordinated and comprehensive analysis of potential environmental impacts. The decision to be made by each agency is to grant or deny the necessary permits or approvals for Noranda to operate the Montanore Project. Permitting decisions will be based on the environmental effects and consequences as documented in this draft EIS, along with other information presented during agency decision-making processes, to determine what conditions are necessary should the project be approved.

DEVELOPMENT OF ALTERNATIVES

Under MEPA, NEPA, and MFSA regulations, the agencies are required to consider the environmental effects of a proposed action and of reasonable alternatives to that action. Two alternatives which must be considered in the draft EIS are the "proposed action" alternative—construction, operation and reclamation of the Montanore Project as proposed by Noranda—and the "no action" alternative, or denial of permits and approvals.

Public participation has been sought and encouraged during preparation of the EIS. The first opportunity for public involvement occurred very early in the EIS process when "scoping" was conducted. During scoping, a list of environmental issues related to the proposed action was developed based on public comments and agencies' analysis. The development of alternatives and assessment of impacts focused on the significant environmental issues. A public meeting was held in Libby on August 9, 1989 to record concerns of people interested in Noranda's Montanore Project. A number of written comments were also received during the scoping period. Another meeting was held on February 15, 1990 to discuss Noranda's petition to the Board of Health and Environmental Sciences to change the quality of ambient water.



Source: Noranda Minerals Corp. 1989a.

FIGURE S-1.
PROPOSED LOCATION OF MONTANORE PROJECT FACILITIES

Based on the range of environmental issues identified by the public during scoping and the agencies' analysis, the agencies identified six significant environmental issues to drive the development of alternatives and evaluation of impacts—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quantity and quality of water resources.

A number of alternatives were considered during the scoping process. Alternatives other than the no action alternative and Noranda's proposal were then developed in response to environmental issues to determine whether there was opportunity to minimize the potential negative project impacts through modification of planned operations or relocation of any or all of the proposed project facilities. Seven alternatives evaluated in detail in the EIS are—

- Alternative 1–Noranda's proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3–Noranda's mine proposal with modifications and with water treatment;
- Alternative 4–Noranda's transmission line proposal with modifications;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action alternative.

Several categories of alternatives were evaluated by Noranda and the agencies, but dismissed from detailed analysis in this draft EIS. These alternatives were found to be either technically, economically or environmentally infeasible. The range of alternatives considered include—

- siting of surface mine facilities;
- power supply sources and transmission line routings;
- transmission line construction methods;
- tailings embankment construction methods;
- tailings disposal techniques;
- seepage control techniques; and
- joint venture mineral development.

ALTERNATIVES DISCUSSED IN THIS EIS

Development of the Montanore Project as proposed (Alternative 1) would require disturbing six areas during construction of project facilities (Figure S-1). The mine, mill and two adits would be in upper Ramsey Creek, about one-half mile from the Cabinet Mountains Wilderness boundary. An additional adit, currently being constructed along Libby Creek on private lands under a permit issued by the DSL, would be used for ventilation. A tailings impoundment is proposed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two percolation pond areas would be used for disposal of excess water. Noranda would upgrade the Bear Creek Road (USFS Rd. 278) and two other KNF roads. A transmission line to supply electrical power would be constructed from a newly constructed substation near Sedlak Park to the Ramsey Creek plant site.

The mining project would be developed over a 2 to 3-year period with a peak construction and operations employment of 530 persons. The mine would operate for 16 years with an operations workforce of 450 persons. Construction of facilities and Noranda's proposed operating and reclamation plans are described in detail in the draft EIS.

Alternative 2 consists of modifications to Noranda's mine proposal. Modifications proposed by the agencies to Noranda's mine proposal include mitigating measures designed to reduce or eliminate adverse environmental impacts and increase the amount of operational and post-operational monitoring. Alternative 3 consists of Noranda's mine proposal with modifications (Alternative 2) and with water treatment. Three water treatment systems which would result in less change in water quality are described in Alternative 3.

Alternative 4 is Noranda's transmission line proposal with modifications. As with Alternative 2, the modifications proposed would reduce or eliminate adverse environmental impacts. Alternative 5 would realign the transmission line route from the upper Miller Creek drainage to the mouth of Ramsey Creek. Alternative 6 would realign the transmission line route from the Fisher River to the mouth of Ramsey Creek. Both alternatives include construction and operation of the transmission line using Noranda's proposed methods, except the modifications described in Alternative 4 would be incorporated. Alternative 7 is the "no action" alternative; Noranda would not develop the Montanore Project.

THE AFFECTED ENVIRONMENT

The proposed project area comprises a 3,221-acre mine permit area and a 988-acre transmission line corridor. About 1,225 acres are proposed for surface disturbance in the project area. The project area is situated in the Kootenai National Forest 18 miles south of Libby in northwestern Montana. Elevation of the project area ranges from 2,800 feet along the Fisher River to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is largely influenced by elevation and topography. Two tributaries of the Kootenai River, Libby Creek and the Fisher River, provide surface water drainage.

Public lands are managed by the KNF under the multiple use policies of the KNF Forest Plan. Small areas of private land occur in the project area. Timber harvesting, recreation, and wildlife habitat are the predominant land uses. The affected environment is described in detail in the draft EIS.

CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES

As proposed, the Montanore Project would result in significant impacts in three areas—surface water quality, wildlife habitat, and general forest recreational activity. Some changes also would occur in the socioeconomic environment of Lincoln County and Libby, and in wilderness attributes in the Cabinet Mountains Wilderness. These changes are described in the following sections. Based on the agencies' analysis, Alternatives 3 and 6 would have fewer adverse environmental effects than other alternatives. The agencies will identify a preferred alternative for the mine and transmission line in the final EIS.

Changes in Surface Water Quality

Alternative 1 may violate water quality standards during initial mine development and prior to mill operation (Years 2 to 3 of the construction period). The standards would only be violated during annual periods of low flow. Additional measures described in Alternative 2 and 3, that would meet water quality standards, would be undertaken.

Under Alternative 1, Noranda would implement a monitoring program designed to evaluate compliance with applicable regulatory standards. The monitoring program is also designed to develop information on water management, particularly on the quantity and quality of tailings impoundment seepage and mine inflows. Noranda would revise the proposed water management plan in response to the monitoring information.

As part of Alternative 2, the agencies have expanded the monitoring program in response to uncertainty

perceived in Noranda's proposal. In addition to measures proposed by Noranda, Noranda would be required to design and seek agency approval of a detailed water management plan to ensure surface water quality standards are maintained for all phases of the project.

Under Alternative 3, Noranda would construct a series of gravel drains beneath the tailings impoundment and dam to intercept seepage prior to entering ground water. The drain system, which would cost about $1.5 million, would be coupled with a water treatment system. Three water treatment alternatives have been developed and described. Based on treating 950 gpm of mine and adit water for a short-term period (three years during construction), conceptual capital costs of the alternatives would range from about $3 million for a wetland system to about $12 million for an evaporator system. Treatment of tailings seepage during operations would have capital costs about one-third of these amounts. Operating costs for all treatment systems would be higher. Final design of a treatment system may result in revised costs. No standards would be exceeded following treatment by any of the three systems. A waiver to the non-degradation provisions would be required for all systems. The transmission line alternatives would have little effect on surface water resources.

Changes in Wildlife Habitat

The Cabinet Mountains provide habitat for a small population of grizzly bears, a threatened species. The project area also provides habitat for a variety of big game wildlife, such as elk, moose, black bear and mountain goat. Mining and increased activity such as general recreation and hunting, would displace these species from some of the habitat presently used in the project area. Other wildlife impacts would be similar for Alternatives 2 through 6.

Noranda would replace affected grizzly bear habitat through road closures, habitat acquisition, or habitat enhancement and protection. Noranda has proposed that the KNF implement year-round closure of three National Forest System roads (10.9 miles) and seasonal closure of four National Forest System roads (20.1 miles). The KNF has two of these roads (5.8 miles) under consideration for permanent closure. These road closures may provide the necessary replacement for the grizzly bear habitat that would be affected by the project. Noranda would replace habitat not compensated by road closures by acquiring conservation easements on suitable private land over an 11-year period and then administering easements over the life of the project.

Increased human-caused grizzly bear mortality, would be an indirect effect of the project. Under Alternative 1, Noranda would fund the salaries of two wildlife professionals; one would be responsible for law enforcement and one would develop and implement an educational and informational program. Noranda would also support selective changes in the hunting regulations to reduce mortality risk. Road closures might reduce mortality.

Under the remaining action alternatives, impacts to grizzly bears would be the same. The agencies developed an alternative grizzly bear mitigation plan, which would be implemented if Alternative 2 or 3 is selected. All affected habitat would be replaced through habitat acquisition of nearly 4,700 acres over a four-year period. Under Alternative 2 or 3, Noranda would fund the salaries of two wildlife professionals from the Montana Department of Fish, Wildlife and Parks for increased information and education, and law enforcement programs. A detailed information and education program would be implemented.

Changes in wildlife habitat resulting from the project would not occur under Alternative 7. The grizzly bear recovery plan currently being implemented in the Cabinet Mountains would continue.

Changes in General Forest Recreational Activity

During the construction phase of the project, a significant increase in traffic would occur on the Libby Creek and Bear Creek roads. The Bear Creek

Road would be widened to accommodate the increased traffic. The increased traffic would likely affect those recreational users who use the forest for travel and viewing pleasure, the primary recreational use in the project area. Road closures, both those proposed by Noranda for grizzly bear mitigation (see next section), and those under consideration by the KNF to comply with KNF Forest Plan standards, would further reduce motorized recreational opportunity. Some of the roads proposed for closure are in areas managed for non-motorized recreation. Closure would increase semi-primitive, non-motorized recreational opportunity.

The 595-acre tailings disposal facility (impoundment and dam) would be permanent and would affect the views of the Cabinet Mountains from several locations along Libby Creek Road. Although Noranda's proposed reclamation plan would likely result in reforestation of the impoundment area, the landform which would be created by the facility would remain incongruent with the surrounding landscape.

The impoundment and other project facilities, such as the plant site and transmission line, would also be visible from locations within the Cabinet Mountains Wilderness. The transmission line would be visible from the Libby Creek Recreation Gold Panning Area and the Howard Lake Campground.

Alternatives developed by the agencies are intended to reduce or avoid these potential impacts. Under Alternatives 2 and 3, Noranda would develop a mandatory busing program to be implemented during the operation phase and a transportation plan for the construction phase to reduce traffic on the access roads. This mitigation would significantly reduce traffic levels.

Noranda would implement several modifications to address potential visual effects as part of Alternatives 2 and 3. The two primary modifications are development of three additional viewpoints along the Bear Creek and Libby Creek roads with views focusing on the Cabinet Mountains and development of a roadside tree management program with the goal of obscuring any project facilities along primary travel routes.

The transmission line would be routed away from developed portions within the Libby Creek Recreation Gold Panning Area under the transmission line alternatives (4, 5 and 6). Transmission line Alternatives 5 and 6 would reduce visual impacts from the Howard Lake area.

Changes in the Socioeconomic Environment

Operation of the Montanore Project would create 450 new jobs, and increased business activity in Lincoln County would create another 200 jobs. Employment during the three-year construction phase would be slightly higher. About $13.8 million in annual personal income would result from project operations. A long-term population increase estimated to be 319 people would be less than two percent of the present population in Lincoln County. A peak population increase of 411 people would occur during the construction phase. Increased housing and community services would be necessary to accommodate increased growth. An estimated 90 housing units would be needed by project workers and their families during the operations period; 105 housing units would be needed during the construction phase. No work camps would be developed. Under the Hard Rock Mining Impact Plan, Noranda would pay for all increased costs to local government units resulting from the project.

Under Alternative 7, these socioeconomic changes would not occur. Existing high unemployment levels would likely remain.

Changes in Cabinet Mountains Wilderness

The proposed project would be near the Cabinet Mountains Wilderness, with the proposed plant site and adits adjacent to the wilderness boundary in Ramsey Creek. Current recreational users of the Ramsey Creek drainage seeking the opportunity for solitude and primitive recreation, would likely be displaced. Access to upper Ramsey Creek above the

plant site would be restricted. Project facilities would affect the views of climbers of some wilderness peaks (~150 people).

Increased noise levels, particularly during construction, and increased concentrations of air-borne pollutants would occur in upper Ramsey Creek. Levels of air-borne pollutants are expected to be well below applicable standards. No subsidence and no effects to surface water resources is expected in the wilderness.

Under Alternatives 2 and 3, some noise reduction would occur through mitigation. Increased monitoring would occur for surface and ground water resources, and for air quality around the proposed plant site. The transmission line alternatives would not affect wilderness characteristics.

Under Alternative 7, the current characteristics of the Cabinet Mountains Wilderness would remain. Areas around the proposed plant site would not be affected.

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THE EIS AND PERMITTING PROCESS FOR THE MONTANORE PROJECT

THIS draft EIS for the Montanore Project describes the possible environmental consequences of proposed government agency actions and alternative actions. In this EIS and permitting process, proposed actions and alternatives (such as the approval of permits for a new mining operation) are carefully weighed and evaluated. This draft EIS embodies and documents the process to be used to make a decision. It is the product of many hours of review and analysis by agency officials and technical specialists. Public participation was an important component. A significant effort was made by the applicant, Noranda Minerals Corporation, in responding to requests for additional information during the review of the permit application and preparation of this EIS. Environmental issues expressed by the public in meetings and in written comments to the agencies have been incorporated into the analysis.

PURPOSE AND NEED

The Proposed Action—the Montanore Project

The "Montanore Project" is a proposed underground copper and silver mine. The project is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. Noranda would be the operator. The mine and mill would be located in Lincoln County, about 18 miles south of Libby, Montana (Figure 1-1). The project would include construction of a mill for ore processing and attendant mine waste disposal facilities. The proposed project would also require construction of about 16 miles of high voltage electric transmission line to the project site. Noranda's proposed plan of operation is described more fully in Chapter 2.

NEPA, MEPA, and MFSA

Procedures governing the EIS analysis process in Montana are defined in administrative rules implementing the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act

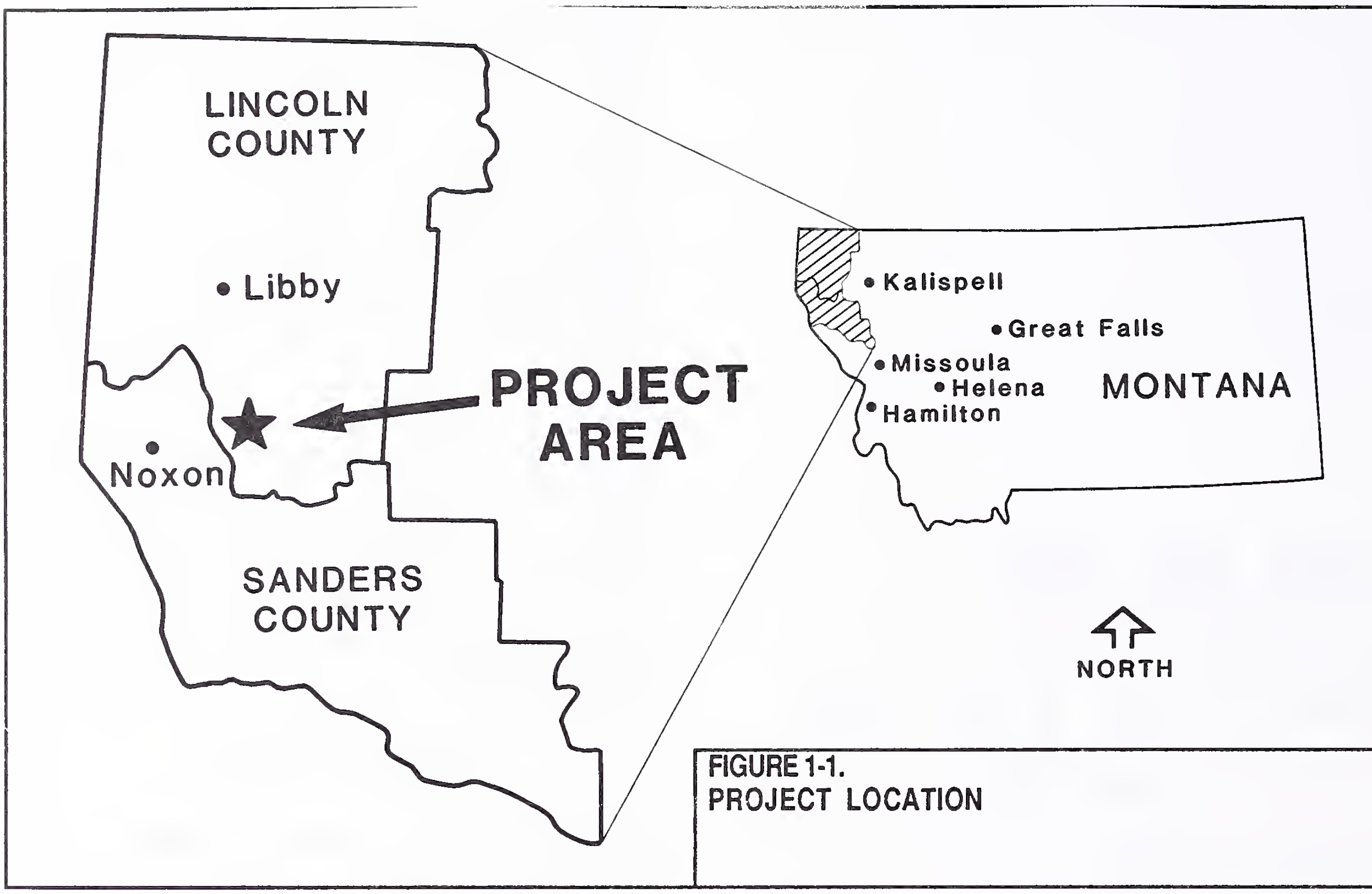


FIGURE 1-1.
PROJECT LOCATION

(MEPA), and the Montana Major Facility Siting Act of (MFSA). This draft EIS was written to meet the requirements of these statutes and the administrative rules implementing these laws adopted by participating state or federal agencies.

These laws require that if any action taken by the State of Montana or the U.S. Forest Service may "significantly affect the quality of the human environment," an EIS must be prepared. This EIS and permitting process entails several steps. Scoping takes place first. During scoping, the public is afforded the opportunity in a public meeting to express concerns and identify issues to be addressed in the EIS. Written comments also are solicited. In this draft EIS, the elements of the environment which would be affected by the proposed action and alternatives are described. The proposed action and reasonable alternatives to the proposed action are outlined and then an analysis of the consequences (impacts) of the proposed action and alternative actions is conducted. The results of the analysis are documented in this draft EIS. A formal public review and comment period occurs after publication of a draft EIS, during which written and oral comments and questions on agencies' analysis of the project and alternatives are solicited. A public meeting is held during this comment period affording an additional opportunity for public participation. Comments and questions received during the public comment period are reviewed and analyzed, and are incorporated in the final EIS as appropriate.

In preparing a final EIS, previously analyzed alternatives may be modified, and substantive public comments are considered and addressed. Additional information on the proposed action might be requested and further analysis of existing alternatives

might be conducted. The purpose of a final EIS is to delineate and document the recommended actions for consideration by each agency's decision maker or decision-making body (see next section). Each agency must issue a Record of Decision documenting the decision made and the reasons for such a decision.

THE AGENCIES

For this project, four "lead" agencies have been designated. Lead agency approvals required for the Montanore Project would be major federal or state actions each requiring an EIS under MEPA, NEPA or MFSA. A single EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. The lead agencies are the Kootenai National Forest (KNF), the Montana Department of State Lands (DSL), the Montana Department of Natural Resources and Conservation (DNRC), and the Montana Department of Health and Environmental Sciences (DHES).

The agencies must take certain actions on the applications submitted by Noranda for the Montanore Project. As one possible action, the agencies may approve the applications or Plan of Operation as submitted by Noranda. The agencies may deny approval. Other possible actions by the agencies would be approval of modified applications or Plan of Operation or approvals with stipulations. Such actions may require Noranda to mitigate environmental impacts by adopting measures which are not a part of the original project plan. This draft EIS encompasses actions, alternative actions, and analyses considered by the agencies in making decisions on the permits and approvals required for the Montanore Project.

Kootenai National Forest

A majority of the proposed Montanore Project facilities and all of the ore deposit are on lands administered by the Kootenai National Forest. The Organic Administration Act authorizes the Secretary of Agriculture to regulate occupancy and use of national forest lands for the protection and management of forest resources. Regulations for mining activities on national forest lands are contained in 36 CFR Part 228, Subpart A. They require that a proposed plan of operation be submitted for activities that could result in significant disturbance to surface resources. Regulations for special uses on national forest lands are contained in 36 CFR 251. They require that a special use application be filed for uses such as constructing and operating a transmission line. Both regulations require that the applicant describe the proposed operation, environmental protection measures, and reclamation specifications.

Noranda has submitted a proposed plan of operation and special use application for the Montanore Project to the KNF (Noranda Minerals Corp., 1989a). The Supervisor of the KNF will issue his decision with respect to Noranda's proposal in a Record of Decision (see Agency Decisions in this Chapter). Noranda may appeal the decision pursuant to 36 CFR Part 217 or 251. Other parties wishing to appeal the decision may do so in accordance with appeal procedures provided in 36 CFR Part 217.

The KNF shares responsibility to monitor and inspect the Montanore Project, and has authority to ensure that impacts to surface resources are minimized through modifications to an approved Plan of Operation. The DSL would collect a bond from Noranda to ensure that the lands involved with the mining operation are properly reclaimed. This would be held to ensure performance of the State permit and Forest Service plan of operations, as stipulated in a 1989 Memorandum of Understanding between the Forest Service–Northern Region and the DSL. The KNF may require an additional bond if it determines that the bond held by the DSL is not adequate to reclaim National Forest System lands or would be administratively unavailable to meet Forest Service requirements. The KNF would collect a reclamation bond for National Forest System lands

affected by the transmission line. The DNRC would collect a reclamation bond for private lands affected by the transmission line.

The KNF will prepare a Biological Assessment to comply with the Endangered Species Act which will be included in the final EIS. The KNF will consult with the U.S. Fish and Wildlife Service to design mitigation measures for the affected species and their critical habitat. It is the KNF's responsibility to ensure mitigation measures are satisfactorily implemented.

Mineral rights. The Montanore Project ore body is located within the Cabinet Mountains Wilderness (CMW). The mineral rights were purchased from U.S. Borax and Chemical Corporation (Borax) in 1988 by Noranda and its partner, Montana Reserves. Noranda has claimed this ore under rights granted by the General Mining Law of 1872, as amended, and the Wilderness Act of 1964. The General Mining Law grants citizens the right to prospect for, lay claim to, and develop certain minerals such as copper and silver on public domain lands open to mineral entry.

The CMW was open to mineral entry until January 1, 1984. At that time, it was withdrawn from mineral entry under provisions of the Wilderness Act, subject to valid existing rights. To establish valid existing rights, a mining claimant must show that they had made a discovery of a valuable mineral deposit on the claim(s) prior to the withdrawal date, and maintained that discovery to the present. The Forest Service's role is not to adjudicate the mineral rights of claimants, but rather to ensure that valid rights have been established prior to approving an operation in the wilderness. A mineral report prepared by the Forest Service in 1985 verified that Borax (Noranda's predecessor) had established valid rights to minerals within the CMW. Since that time, the Forest Service has continued to review the status and limits of those mineral rights. More information on the mining claims and Noranda's mineral rights is presented below.

In 1982 and 1983, Pacific Coast Mines, Inc. (a corporate affiliate of Borax) located 202 individual lode mining claims within the CMW in an area between Rock Lake and Hayes Ridge. These claims are referred to as the HR claim group. Borax found a mineralized outcrop on these claims adjacent to Rock Lake in 1983. This outcrop contained stratabound copper-silver mineralization, extending over a 200-foot vertical thickness. This disseminated mineralization was identical in nature to, but much thicker than, that discovered in the outcrop at ASARCO's Spar Lake (now the Troy Mine) and Rock Creek deposits. The outcrop was sampled in 1983 by Borax, and jointly by the Forest Service and U.S. Bureau of Mines. Borax subsequently requested and was granted approval by the KNF to core drill on this mineralized outcrop. Initial drilling was conducted on the outcrop in 1983. Additional drilling was conducted in 1984. Borax also drilled two core holes in 1983 on the HR claims near the East Fork of the Bull River.

Based on the drilling, surface sampling, geologic mapping and other data, Borax concluded they had discovered the apex of a large, stratabound copper-silver deposit. An apex is the top or highest point along a dipping lode or vein. The company believed that the apex was at the mineralized outcrop adjacent to Rock Lake, and that they had extralateral rights associated with that apex. The Mining Law of 1872 entitles a claimant to mineralization extending in a downward course off the sidelines, but within the endlines of the apex claims. This is referred to as extralateral rights.

Borax wanted to continue development drilling on the copper-silver ore body. Before they could conduct this drilling, however, the Forest Service had to verify that Borax had established valid existing rights prior to the wilderness withdrawal. The Forest Service conducted a mining claim validity investigation for that purpose. The investigation included field and map review of claim locations, an examination of the claim and area geology, review and sampling of drill cores and the discovery

outcrop, and sampling of other mineral exposures within the claims. These other mineral exposures consisted of pits and workings in and near the St. Paul Pass area. The results and findings of the claim examination were documented in a Forest Service mineral report dated February 27, 1985. This report is available at the KNF. Its purpose was to assess what rights, if any, Borax had established in the wilderness, and to make recommendations on whether they should be allowed to conduct development drilling operations.

The report verified that Borax had established valid existing rights on four of the 202 HR mining claims (Figure 1-2), and that these four claims were exempted from the withdrawal provisions of the Wilderness Act. The other 198 claims were found to be invalid. The report concluded that the four valid claims contained the apex of a large, stratabound copper-silver deposit and that Borax was entitled to extralateral rights to mineralization extending beyond the sidelines of those claims. The HR claims were sold to Noranda and Montana Reserves in September, 1988.

Borax requested and was granted approval to drill beyond the sidelines of the valid claims in order to develop the property and delineate the full extent of their extralateral rights. This drilling was conducted in 1985, 1986, and 1987. A total of 29 core holes have been drilled from 9 separate sites within the known deposit area. Twenty-seven of these holes penetrated ore grade mineralization. One drill hole penetrated the Rock Lake Fault without encountering the mineralization. One hole was abandoned prior to reaching a mineral intercept. Forest Service personnel carefully monitored the drilling activities to ensure compliance with environmental requirements. All of the drill data was provided to the Forest Service. This information included drill logs, assay and geochemical values obtained from drill samples, and down-hole survey data. In addition, the agency was provided full access to examine and independently sample the drill cores.

Information reviewed to date indicates that Noranda has valid mineral rights in the CMW and, therefore, has the legal right to conduct mining operations in the CMW. The status and extent of these rights are subject to ongoing review by the Forest Service. This review will continue at least until Noranda obtains mineral patent to the claims, should Noranda apply for mineral patent. Updated information will be presented in the final EIS regarding the status and extent of Noranda's mineral rights in the CMW. This information will be used to determine the extent of operations that the Forest Service can approve in the CMW.

Montana Department of State Lands

The Montana Department of State Lands administers the Montana Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3, MCA), under which Noranda has applied for a permit (Noranda Minerals Corp., 1989a). The purpose of this law is to prevent land and surface water degradation by requiring lands disturbed by mining to be stabilized and reclaimed. The Metal Mine Reclamation Act requires an approved operating permit for all mining activities which disturb more than five acres, or mine more than 36,500 tons of ore annually. Noranda's permit application contains environmental baseline information and a plan of operation and reclamation, including descriptions of proposed mining and milling methods, engineering designs, surface facilities, waste disposal practices, erosion and pollution control systems, reclamation methods, and environmental monitoring procedures.

The DSL must decide whether to issue Noranda an operating permit, and if so, under what conditions (see Agency Decisions in this chapter). The Montana State Land Commissioner may make a decision to approve Noranda's permit application no sooner than 15 days following publication of the final EIS. Before an operating permit may be issued, a reclamation performance bond must be posted with

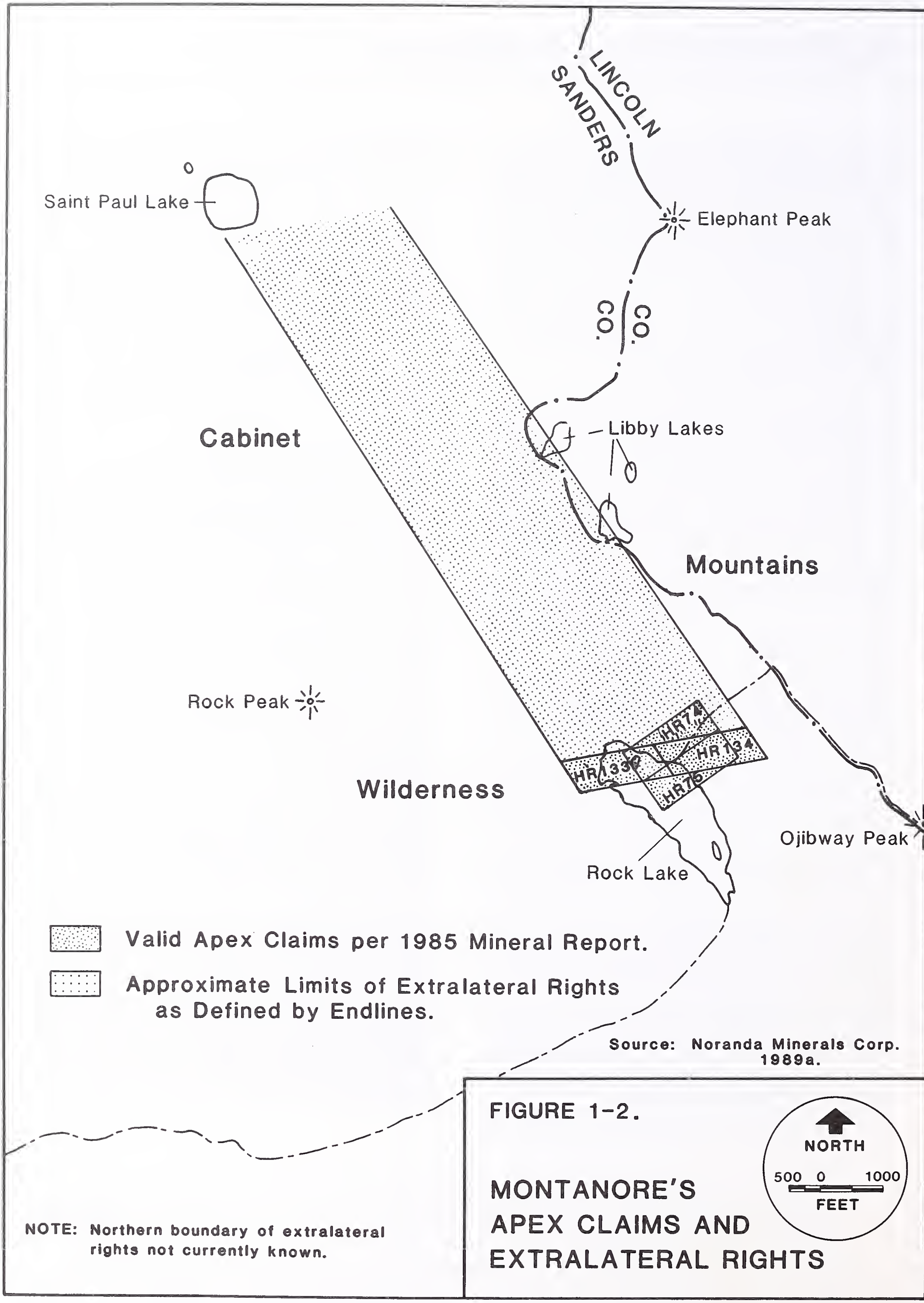


FIGURE 1-2.

MONTANORE'S APEX CLAIMS AND EXTRALATERAL RIGHTS

the DSL. The bond amount must be sufficient for the state to complete reclamation in case of default by the operator. In order to ensure continuity between DSL and DHES actions, the DSL will render its decision in accordance with recommendations of the DHES, or will conditionally approve the permit application subject to DHES approval.

Major changes in the operating or reclamation plans would require prior approval by the DSL. The DSL would routinely conduct inspections of the Montanore Project to ensure compliance with approved plans. Monitoring data collected by Noranda would be evaluated and, if necessary, compliance monitoring would be performed. Monitoring activities would be coordinated with other state and federal agencies. The DSL can issue notices of violation and levy civil penalties in enforcing its regulations.

Montana Department of Natural Resources and Conservation

The DNRC administers two acts that can apply to mining development in Montana—the Montana Major Facility Siting Act and the Montana Water Use Act. Noranda has submitted an application for approval to construct a 230-kV electrical transmission line pursuant to MFSA requirements (Noranda Minerals Corp., 1989c). Noranda has applied for and will be required to obtain water use permits prior to start of construction.

The Major Facility Siting Act requires approval of any electrical transmission line as large as the line proposed by Noranda. The Montana Major Facility Siting Act requires the Board of Natural Resources and Conservation (BNRC) to determine whether a proposed project is needed and is properly designed and located to minimize adverse impacts, considering the state of available technology and the nature and economics of the alternatives. In making its determination, the BNRC would hold a contested case hearing and consider analysis prepared by the KNF, the DNRC, the DHES and any other parties participating in the hearing.

The DNRC prepares recommendations for the BNRC regarding whether lines should be built, where and how they should be constructed, how they should be operated and how impacts could be mitigated. These recommendations are included along with the DNRC's analyses in the final EIS. The BNRC also will issue a Record of Decision for the transmission line following completion of the hearing process.

The DHES is required to determine whether transmission line construction requires air quality, water quality, or solid waste disposal permits. On July 13, 1990, the DHES determined that the construction, operation and maintenance of the proposed transmission line along alternative locations under DNRC's consideration would comply with the laws under DHES' jurisdiction if certain conditions were met. DHES' determination is on file at the agencies' offices.

The MFSA provides for a two-step decision-making process where the BNRC will first consider a route or a general location for the line and then consider more detailed centerline locations within the approved route. Because of the length of the proposed transmission line, the large areas of federal land crossed, and the need for coordinated decision-making, the DNRC and the KNF will jointly conduct an analysis as part of this EIS which will be sufficiently detailed to provide concurrent route and centerline recommendations to the BNRC.

This draft EIS documents the analysis of a varied width route drawn along a tentative (or reference) centerline alignment. Further adjustments may be made to the alignment following the publication of the draft EIS; any changes will be documented in the final EIS. Following publication of the final EIS, the DNRC and the KNF will present their recommendations to the BNRC in a contested case hearing.

The BNRC's hearing is a formal legal process open to any person who wishes to participate. The

hearing will be conducted by a hearing examiner under provisions of the MFSA and the Montana Administrative Procedures Act. Participants are not required to have an attorney, but all persons presenting evidence will be under oath and subject to cross examination by other parties to the hearing. The DNRC will give prior notice of the dates for the BNRC proceedings to persons participating in the EIS process.

Under 75-20-301, MCA, the BNRC hears testimony and uses the hearing record to determine the following, where applicable—

- the basis of need for the facility;
- the nature of the probable environmental impact;
- whether the facility represents the minimum adverse environmental impact considering the state of available technology and the nature and economics of the various alternatives;
- whether the facility meets the applicable criteria concerning energy needs and environmental impacts set forth in section 75-20-503, MCA;
- what part, if any, of the line should be located underground;
- whether the facility is consistent with regional plans for expansion of the interconnected electrical grid;
- whether the facility will serve the interests of the electrical system economy and reliability;
- whether the facility could be built at a specific location to conform to applicable state and local laws;
- whether the facility will serve the public interest, convenience, and necessity;
- that the DHES has issued any permits required within its jurisdiction; and
- that the use of public lands for location of the facility was evaluated and public lands were selected whenever their use is as economically practical as the use of private lands and compatible with the environmental criteria in the MFSA.

After the hearing, the BNRC will either approve or disapprove the transmission line. If the BNRC approves the line, it will describe what conditions, if any, should be attached to the Certificate of Environmental Compatibility and Public Need, including any requirements for additional centerline studies to determine the final alignment. The BNRC may disapprove the transmission line if it can be shown, based on the hearing record, that the criteria established by law and implementing rules cannot be reasonably met. Following a decision by the BNRC, the KNF may require the preparation of a project work plan detailing the final pole and access road locations across KNF lands. The DNRC and the KNF would monitor construction of the proposed transmission line.

The Montana Water Use Act of 1973 established a permit system for the acquisition of a water right. If a developer does not have an existing water right, the law requires a water use permit before water can be put to beneficial use. Noranda's water use during operations would be a beneficial use allowed by law. Since Noranda does not have an existing permanent water right, Noranda would be required to obtain water use permits for ground water or surface waters used in the construction or operation of the mine and mill. Based on the application for a mine operating permit submitted to the DSL, Noranda would be required to obtain permits for the use of ground water for domestic purposes at the mine site, and for mine construction and operation. Ground water would be withdrawn through a well at the mine site and from adits in Ramsey Creek or Libby Creek. Noranda has applied for a water use permit for withdrawal of ground water at a rate of 1,200 gallons per minute, not to exceed a total diversion of 1,860 acre-feet per year. Noranda will be required to obtain necessary permits before construction begins.

Under 85-2-317, MCA, an appropriation of ground water in excess of 3,000 acre-feet per year requires approval of the Montana Legislature before a permit can be issued. Without further act of the legislature, the DNRC is responsible for determining whether water use permits could be issued for ground water withdrawals up to 3,000 acre feet per year. Noranda

would be required to prove by substantial and credible evidence that the following criteria in 85-2-311(1), MCA would be met—

- there are unappropriated waters in the source of supply at the proposed point of diversion at times when water can be put to the proposed use by the applicant; in the amount the applicant seeks to appropriate; and during the period in which the applicant seeks to appropriate, the amount requested is reasonably available;
- the water rights of a prior appropriation will not be adversely affected;
- the proposed means of diversion, construction, and operation of the appropriation works are adequate;
- the proposed use of water is a beneficial use;
- the proposed use will not interfere unreasonably with other planned uses or developments for which a permit has been issued or for which water has been reserved; and
- the applicant has a possessory interest (ownership), or the written consent of the person with the possessory interest, in the property where the water is to be put to beneficial use.

Based on its analysis of the permit application and the above criteria, DNRC will grant, deny, or condition, in whole or in part, the application for a permit. If objections are filed on Noranda's application, the above determination must be made in a contested case hearing held by the DNRC.

Montana Department of Health and Environmental Sciences

Air Quality Bureau. The Air Quality Bureau administers the Montana Clean Air Act. Any proposed project having estimated pollutant emissions (without emissions controls) exceeding 25 tons per year must obtain an air quality permit. Noranda has applied to the Air Quality Bureau for an air quality permit for the Montanore Project (TRC Environmental Consultants, Inc., 1989). The permit would specify air emissions limitations and monitoring requirements. Noranda must apply Best Available Control Technology to each emissions source, and must demonstrate that the project would not violate Montana or federal Ambient Air Quality Standards. The Air Quality Bureau would conduct periodic inspections to ensure permit compliance.

Water Quality Bureau. The Water Quality Bureau is responsible for administration of the Montana Water Quality Act. This law provides a framework for the classification of surface and ground water uses. It also establishes surface water quality standards as well as permit programs to control the discharge of pollutants into state waters.

Mining operations must comply with Montana surface and ground water standards. Tailings impoundment, sewage treatment plant and other facilities must be constructed and operated to prevent water discharge, seepage, drainage, infiltration, or flow that may degrade surface or ground waters. Final design plans for the tailings pond, sewage treatment plant, and other facilities proposed by Noranda must be approved by the Water Quality Bureau prior to construction. A short-term exemption from surface water quality standards for turbidity may be required for construction of the transmission line and access roads at stream crossings, and for the construction of the substation near Sedlak Creek.

Noranda has petitioned the Board of Health and Environmental Sciences (BHES) through the Water Quality Bureau for a change in quality of ambient waters (Noranda Minerals Corporation, 1989h). The petition describes the proposed change in water quality and considers various water disposal alternatives.

This EIS discusses the petition. The DHES' recommendations will be presented in the final EIS, and the final EIS submitted to the BHES. Following a review of the EIS and a public hearing, the BHES will make its decision. To approve a change in water quality, the BHES must find that the proposed change would not preclude present or anticipated use of surface or ground water; and that there is an economic and social need for the project. The

hearing procedures to be used by the BHES will be based on those described in the nondegradation of water quality rules (ARM 16.20.705 [5]). The Water Quality Bureau will send hearing notices to all persons who have participated in the EIS process. The final BHES action will be documented in a Record of Decision.

Solid and Hazardous Waste Bureau. The Solid and Hazardous Waste Bureau is responsible for reviewing the mine and transmission line construction and operation procedures to ensure implementation of construction and operational plans comply with solid and hazardous waste laws and regulations.

OTHER PERMITS, LICENSES AND APPROVALS

In addition to approvals by the lead agencies required for the Montanore Project, various other permits, licenses or approvals from other agencies also would be necessary (Table 1-1). Agencies involved in these permits or approvals are described in the following sections. Other agencies, such as the Mine Safety and Health Administration, would also be involved with the project, if approved.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service administers the Endangered Species Act and the Bald Eagle Protection Act. The KNF will prepare a Biological Assessment to comply with the Endangered Species Act. The Biological Assessment for the Montanore Project will be included in the final EIS. Following its submittal, the U.S. Fish and Wildlife Service will prepare an official opinion on the project impacts and any cumulative impacts from other activities occurring in the same area. Under federal regulations, the USFWS has up to 135 days in which to render an official opinion.

State Historic Preservation Office

The State Historic Preservation Office (SHPO) must cooperate with and advise the agencies when potentially significant historical, archaeological, or other cultural resources could be affected by the Montanore Project. Under the National Historic Preservation Act, the SHPO provides federal agencies with site value recommendations for cultural resources eligible for the National Register for Historic Places. During mine construction and operation, the agencies would oversee compliance with historic preservation and monitoring plans.

Hard Rock Mining Impact Board

In 1981, the Montana legislature enacted the Hard Rock Mining Impact Act to assist local governments in handling financial impacts caused by large-scale mineral development projects. The legislature recognized that a new mineral development may result in the need for local governments to provide additional services and facilities before mine-related revenues become available. The resulting costs can create a fiscal burden for local taxpayers. The legislature also recognized that some affected local government units may lack jurisdiction to tax a new development. The Hard Rock Mining Impact Board, part of the Montana Department of Commerce, oversees an established process for identifying and mitigating fiscal impacts to local governments. The Board also acts as "referee" in disputes between local governments and project developers.

Noranda will submit a Hard Rock Mining Impact Plan when this draft EIS is published. In the plan, Noranda will identify increased public-sector costs attributable to the Montanore Project. Noranda must pay, according to a specified schedule, all increased capital and net operating costs to local governments. Citizens affected by the project may participate in the impact planning process.

Table 1-1. Permits, licenses, and approvals required for the Montanore Project.

Permit, License or Approval	Purpose
Forest Service	
Approval of Plan of Operation (36 CFR 228 Subpart A)	To allow for mineral exploration and development on Forest System lands. Approval incorporates management requirements to minimize or eliminate effects on other forest resources. Approval is documented in a Record of Decision.
Special Use Permit(s)	To allow respective utility companies to construct and operate electric transmission/distribution and telephone lines on Forest System lands.
Special Use Permit	To allow Noranda to construct and maintain associated facilities such as a weather station or radio tower, outside the designated project area on Forest System lands.
Road Use Permit	To specify operation and maintenance responsibilities on Forest System roads used for commercial hauling of ore concentrate.
Mineral Material Permit	To allow Noranda to take borrow material from Forest System lands.
Timber Sale Contract	To allow Noranda to harvest commercial timber from the project area within Forest System lands.
Cultural Resource Clearance	To obtain joint approval by the Forest Service and State Historic Preservation Office prior to construction activities.
Final Design Approval of Facilities	To ensure consistency of design of plant/ portal site, conveyor system, waste rock disposal site, access roads, utility corridors, waste water treatment facilities, and tailings disposal impoundment with preliminary plans. Coordinate with DSL and other appropriate agencies.
Monitoring Plans (Construction, operation and environmental)	To assure compliance with state and federal environmental resource standards and criteria. Coordinate with other governmental agencies.
Department of State Lands	
State Operating Permit (Metal Mine Reclamation Act)	To allow mining development activity.
Reclamation Bond	To post a sufficient bond with the state prior to commencing construction. Coordinate with Forest Service.
Monitoring Plans	To assure compliance with state and federal environmental standards and criteria. Coordinate with other governmental agencies.
Department and Board of Health and Environmental Sciences Air Quality Bureau	
Air Quality Permit (Montana Clean Air Act)	To control particulate emissions of more than 25 tons per year.

Table 1-1. **Permits, licenses, and approvals required of the Montanore Project (cont'd).**

Permit, License or Approval	Purpose
Department and Board of Health and Environmental Sciences — Water Quality Bureau	
Change in Quality of Ambient Waters (Water Quality Act)	To control discharge to ground and surface waters.
Water Quality Waiver of Turbidity	To allow for short-term increases in surface water turbidity during construction.
Department and Board of Natural Resources and Conservation	
Water Rights Permit (Montana Water Use Act)	To allow beneficial use of state waters obtained through any surface water diversion or through ground water withdrawal exceeding 100 gallons per minute.
Certificate of Environmental Compatibility and Public Need (Major Facility Siting Act)	To construct 230-kV electrical transmission line to supply power to the mine.
Department of Fish, Wildlife and Parks	
FG Form 124 (Stream Preservation Act)	To allow construction activities within the mean high water line of a perennial stream or river.
Bonneville Power Administration	
Record of Decision (National Environmental Policy Act)	To construct, operate and maintain substation and to provide service to the mine power supplier.
Army Corps of Engineers	
404 Permit (Clean Water Act)	To control discharge of dredged or fill material into waters of the United States or on wetlands.
Lincoln Conservation District	
310 Permit (Natural Streambed and Land Preservation Act)	To allow any activity within the mean high water line of a perennial stream. DFWP provides recommendations and consultation.
Hard Rock Impact Board/"Affected local government units"	
Fiscal Impact Plan (Hard Rock Mining Impact Act)	To mitigate fiscal impacts on local government services.
Lincoln County Disaster and Emergency Services Coordinator	
Floodplain permit	To allow construction of facilities within designated 100-year floodplains.

An operating permit issued by the DSL is not valid until an impact mitigation plan has been approved by the Hard Rock Mining Impact Board. An operating permit may also be suspended for non-compliance with the impact mitigation plan. By mutual agreement, Noranda and affected local government units may amend an approved impact plan at any time by petitioning the Board. Either party may also petition to amend the plan under conditions established in the plan, or, if within two years after commercial production begins, the plan is materially inaccurate because of errors in impact assessment. If a local government unit not included in the plan believes that it should have been, it may petition the Board to amend the impact plan.

U.S. Army Corps of Engineers

Noranda has submitted a "404 permit" application to the U.S. Army Corp of Engineers. If approved, the Corps of Engineers would issue a 404 permit (referring to Section 404 of the Clean Water Act) for construction or "dredge and fill" activities affecting "navigable" waters or wetlands. All of the drainages in the proposed permit area of the Montanore Project are considered navigable under the Clean Water Act. The 404 permit decision will be documented in a Record of Decision.

Bonneville Power Administration

The Bonneville Power Administration (BPA) would provide a 230-kV power source on its Libby-Noxon line. The BPA would design the switching station, communication system, and system protection requirements. The BPA has contributed to the environmental analysis by assessing impacts from the placement of this equipment. Before agreeing to provide a tap for electrical power for Noranda's project, the BPA would prepare a Record of Decision for its part of the project.

Lincoln Conservation District

Any mining disturbance occurring within the normal high water level of streams outside of KNF boundaries would require the approval of the Lincoln Conservation District. This approval would constitute a "310 permit" under the Natural Streambed and Land Preservation Act. Prior to granting approval, the District would consult with the KNF and the Montana Department of Fish, Wildlife and Parks.

AGENCIES DECISIONS

Prior to construction and operation of the Montanore Project, Noranda must obtain the approval from numerous federal and state agencies. Approval of the project by the individual agencies would necessitate the issuance of permits, licenses, and approvals shown in Table 1-1.

Following closure of the comment period, the lead agencies must evaluate the continuation of the joint EIS process for this project. The agencies would prefer to continue a joint process; however, different statutory time requirements between state and federal processes may preclude this option. As a result, both a state and a federal final EIS might be prepared. The choice of joint or separate final EIS procedures may indirectly affect the sequencing of agency decisions as discussed below.

Sequencing of Agency Decisions

The agencies have a number of options for the sequencing of agency decisions. These options are shown in Table 1-2 and described below. The agencies are seeking public comment on these options. The sequencing option chosen will be described in the final EIS.

Option one would sequence agency decisions to avoid, where possible, decisions conditioned on the future action of another agency having joint decision-making responsibility. Under this option, state

agency decisions would occur first followed by federal agency decisions. The DSL would decide on the mining permit following decisions by the Board of Health and Environmental Sciences (BHES) on air and water permits and on Noranda's petition to change the quality of ambient waters. The Board of Natural Resources and Conservation (BNRC) would decide on Noranda's transmission line application following DSL's and BHES' decisions. The KNF's ROD would be issued following these and other federal, state, and local decisions (shown in Table 1-1), or about six months after the publication of the final EIS.

A second option differs from the first in the timing of a decision on Noranda's mine permit application. Under this option, the BHES would be the first agency to issue a decision. The DSL's decision on the mine would then follow. The KNF would issue a ROD after the USFWS issues its official opinion on the Biological Assessment. The BNRC would hold hearings and decide on the transmission line application after decisions on the mine. The KNF would participate in the BNRC's decision process and amend its ROD as necessary. Other federal and local decisions would be made concurrently following KNF's and DSL's decisions.

A third option involves decision by the DSL shortly after the final EIS, conditioned on approval by the BNRC on the transmission line, by the BHES on necessary air and water quality permits, and by other agencies. The KNF's ROD would be issued concurrent with decisions by the BHES and the BNRC following USFWS' official opinion on the Biological Assessment.

A fourth option involves a conditional decision by the DSL shortly after the final EIS. Assuming an early USFWS' official opinion on the Biological Assessment, the KNF could also issue a conditional decision. The DSL and KNF decisions would be conditional on the BHES and BNRC decisions, which would follow.

Federal Agency Permit Denial

The KNF can deny the Plan of Operation if it finds that Noranda could not take reasonable measures to protect surface resources and public safety. The Montanore Project cannot proceed if the U.S. Fish and Wildlife Service decides, in its official opinion, that the project, as mitigated, would jeopardize the continued existence of a threatened or endangered species. The Army Corps of Engineers can deny a permit if the project would result in significant

Table 1-2. Possible sequencing options for agencies' decisions.

Agency	Option 1	Option 2	Option 3	Option 4
Federal				
KNF	5	4[C]	4[S]	3[C]
USFWS	4	3	2	2
State				
DSL	1[C]	2	1[C]	1[C]
BNRC	3	5	4[S]	5
BHES	2	1	3	4

S = Concurrent
C = Conditional

environmental impact or violate provisions of the Clean Water Act. The Bonneville Power Administration can deny approval if significant environmental impacts would occur, if the interconnected electrical system would not allow adequate service to the mine and existing electrical customers, or if the mine were not approved.

State Agency Permit Denial

Grounds for DSL denial would be a finding that the mining or reclamation plans would violate the laws administered by the DSL (primarily the Metal Mine Reclamation Act), or the water and air quality laws administered by the DHES. Without the approval of the mine by the DSL or the KNF, there would not be the demonstrated showing of need for the transmission line. In such case, the BNRC would likely take action denying the transmission line application. The BNRC may disapprove the transmission line, regardless of actions by other agencies, if it can be shown, based on the hearing record, that the criteria established by the Major Facility Siting Act and implementing rules cannot be reasonably met. Under the Montana Water Quality Act, the BHES can deny Noranda's petition to change the quality of ambient waters if present or anticipated use of surface or ground water would be precluded, or if an economic and social need for the project is not demonstrated.

PUBLIC PARTICIPATION

Public participation is a key element of any EIS. The first opportunity for public involvement occurs in the beginning of the EIS process when "scoping" is conducted. One purpose of scoping is to compile a broad list of environmental issues related to the proposed action, and to rank these issues in order of significance. The subsequent analyses conducted in the EIS process focus on the identified significant issues. The scope of this EIS was established by this process.

A public meeting was held in Libby on August 9, 1989, to record concerns of people interested in the Montanore Project. Another meeting was held in Libby on February 15, 1990, to discuss Noranda's petition for a change in water quality. A number of written comments were also received during this process. A list of all issues and concerns raised in the scoping process were compiled and are presented in Chapter 8 of this draft EIS. All the issues identified during the scoping process are summarized in Table 1-3. The significant environmental issues used to develop alternatives are discussed in Chapter 2.

Table 1-3. Summary of all issues identified during Montanore Project scoping.

Monitoring

Who would conduct the operational and reclamation monitoring?

Who would be responsible for monitoring during temporary closure, and during and following mine closure?

Cumulative impacts

What would cumulative impacts be from Noranda's operation and other reasonably foreseeable activities, particularly on water quality and wildlife?

Hydrology

Is baseline information submitted by Noranda adequate to assess degradation?

What standards would be used to determine degradation?

How would surface water be routed around the tailings impoundment?

Would surface runoff from the various facilities affect the surface water quality?

How would excess water from the mine be handled?

How would seepage from the tailings impoundment be monitored? How would seepage affect surface and ground water quantity and quality?

Mine engineering

What would be the estimated mine life?

How would the various materials used in the milling process be handled and disposed?

How would hazardous materials be handled and disposed?

Would there be any subsidence following mining?

Noise

How much noise would the project generate? Would the operation be heard in the Cabinet Mountain Wilderness?

Land use

What effect would the operation have on recreation, timber harvest, and future multiple uses?

Reclamation

Would the various project components, such as the plant site, tailings impoundment, roads, and transmission line, be reclaimed after the project ends?

What mechanisms would ensure final reclamation?

Recreation

How would the proposed operation affect recreational opportunities?

Socioeconomics

Would the existing level of housing and services be adequate to fulfill the increased needs?

How would the general public be affected through demand for local services?

How many employees would be required by the project and where would the workforce come from? Would job training be available?

What wages and benefits would Noranda pay the employees?

Transportation

How would the transportation of workers and goods affect traffic on U.S. 2 and USFS Road 278?

Would Noranda be responsible for road maintenance?

Would project traffic conflict with other types of forest traffic?

Visual

What would the transmission line's visual impact be?

What project components would recreational users see?

Wildlife

What effect would the proposed operation have on endangered species?

Would mitigation for loss of grizzly bear habitat require closing access to other areas?

How would increased activity in the project area affect wildlife?

2

PROPOSED ACTION, ALTERNATIVES & REASONABLY FORESEEABLE ACTIVITIES

THIS chapter summarizes the proposed action—the Montanore Project, a silver-copper mine, mill, tailings storage facility and transmission line. Reasonable alternatives to the proposed action, including the no-action alternative, are also described. The first section of this chapter, *Development of Alternatives*, describes how the agencies developed alternatives described and analyzed in this EIS. The next seven sections describe Noranda's project proposal and six alternatives, including the "no action" or permit denial alternative. Alternatives dismissed from detailed analysis in this EIS are described in the next section, *Alternatives Considered but Dismissed in this EIS*. The final section, *Reasonably Foreseeable Activities*, discusses the reasonably foreseeable future activities included in the cumulative impact assessment. These include the Rock Creek Project, a silver-copper mine proposed by ASARCO, Inc., road closures, and timber activities. Two other types of development—ski area and other mineral activity—are also described in this section. Subsequent chapters of this EIS discuss the existing environment which might be affected by the alternatives, and the direct, indirect and cumulative impacts of Noranda's proposal coupled with past, present and reasonably foreseeable future activities.

DEVELOPMENT OF ALTERNATIVES

In an EIS, the agencies are required to evaluate the environmental effects of the proposed action and reasonable alternatives to the proposed action. The draft EIS must consider the *no action* alternative and the *proposed action* —

> *No action*—Under this alternative, Noranda would not construct the Montanore Project. The agencies would not grant required permits, and approval for the operation would be denied. The no action alternative provides a baseline for estimating the effects of other alternatives.

> *Proposed action*—Noranda would construct, operate, monitor, and reclaim the Montanore Project as proposed in the plan of operation and

applications. The agencies would issue the necessary permits and approvals.

Other alternatives consist of reasonable modifications to various elements of the proposal. These alternatives fall into two main categories—those that modify the *location of facilities* and those that modify or change the *methods and procedures* employed in the operation.

Location of facilities. Alternative locations for each of the facilities may be considered in response to issues and concerns associated with the proposed facility locations. Alternative locations for the mine portal(s), plant site, tailings impoundment, or corridors which contain roads, powerline, or the tailings pipeline were considered. As discussed in subsequent sections of this chapter, only alternative locations for the transmission line were developed and analyzed in this draft EIS. Locations for other facilities as proposed by Noranda are believed by the agencies to be the most reasonable locations.

Methods and procedures. Noranda has proposed discharge of excess water in percolation ponds and collection of tailings impoundment seepage with a relief well system. Alternative water treatment methods and seepage collection techniques have been considered in response to the issues and concerns associated with the proposed operating or construction plans. Alternatives or additions to Noranda's reclamation and monitoring plans have also been developed.

Through a series of meetings, the agencies determined the environmental issues that would be used as criteria in identifying and evaluating the alternatives. Six significant issues, defined as indicators of potential significant adverse effects, emerged from the scoping process and agencies' discussions. The effects have the potential to be severe or long-lasting, could affect a large area or could occur frequently when a resource's quantity, quality, fragility, or uniqueness are considered. They are—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quantity and quality of water resources.

A number of alternatives were considered during the scoping process. Alternatives other than the proposed action alternative and the no action alternative were then developed in response to identified environmental issues. The intent of these alternatives was to minimize potential negative environmental impacts through modification of planned operations or relocation of any or all of the proposed project facilities. Seven alternatives are described in the following sections and evaluated in detail in the EIS including—

- Alternative 1–Noranda's proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3–Noranda's mine proposal with modifications and with water treatment;
- Alternative 4–Noranda's transmission line proposal with modifications;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action.

Alternative 1 is Noranda's mine and transmission line proposal as described in the plan of operation and applications submitted to the agencies. Alternative 2 consists of the agencies' proposed modifications to Noranda's mine proposal. These

modifications are intended to reduce or avoid the possible impacts identified during the agencies' analysis of the proposal. The six significant issues were considered in developing proposed modifications.

Alternative 3 describes three water treatment alternatives that would reduce potential effects to water quality. Issue 6—effects on water resources—was the primary issue addressed by this alternative. Issue 1–effects on wildlife—also was important in developing this alternative.

This draft EIS documents the analysis of a varied width transmission line route drawn along a tentative alignment for each transmission line alternative discussed as Alternatives 1, 4, 5, and 6 in the draft EIS (Figure 2-1). Further adjustments may be made to proposed alignments following publication of the draft EIS; any changes will be documented in the final EIS.

Alternative 4 consists of modifications in the transmission line location and construction methods proposed by Noranda. A route adjustment in the area of Howard Lake has been proposed by the agencies. The modified route would avoid crossing portions of the Libby Creek Recreation Gold Panning Area. The route modification responds to Issue 2. Proposed modifications to line construction methods would result in less clearing and surface disturbance, in response to Issues 1 and 5.

Alternatives 5 and 6 respond to Issue 1 concerning wildlife impacts, and Issue 2 concerning recreational effects. These alternatives would reduce or avoid impacts to developed recreation areas and have less impact on big game habitat.

Alternative 7–No action or permit denial, is required by MEPA and NEPA. Existing baseline conditions and trends would be maintained. Fiscal effects, such as increased direct and indirect revenues to workers and government units, would not occur under Alternative 7.

ALTERNATIVE 1—NORANDA'S PROPOSAL

Development of the Montanore Project would require disturbing six areas during construction of project facilities (Table 2-1, Figure 2-2). The mill and mine adit would be in upper Ramsey Creek, about one-half mile from the Cabinet Mountains Wilderness boundary. An additional adit, currently being constructed on private land along Libby Creek under an exploration permit issued by the DSL in 1989, would be used for ventilation. A tailings impoundment is proposed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two percolation pond areas are proposed to allow for discharge of excess water. Waste rock would be stored at one percolation pond area, and at the Libby

Table 2-1. Surface area disturbance associated with the Montanore Project.

Facility	Disturbed area (acres)	Permit area (acres)
Libby Creek adit area	18.7	219.4†
Transmission line, substation and roads§	199.0	987.9
Ramsey Creek plant site	44.9	185.2
Waste rock storage area and percolation pond No. 1	58.0	246.0
Percolation pond No. 2	20.0	225.7
Access road—Ramsey Creek plant site to tailings impoundment	99.4	214.9
Access road—Libby Creek adit site to Ramsey Creek Road	34.4	93.8
Access road—U.S. 2 to tailings impoundment	22.0	
Little Cherry Creek tailings impoundment site	728.7	2,036.0
Total	1,225.1	4,208.9

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-18.
†Permitted under a DSL exploration permit.
§Assumes 1.0 acre for Sedlak Park substation and 0.25 acre for microwave repeater on Barren Peak

Creek adit area. A transmission line to supply electrical power would be constructed from Sedlak Park to the Ramsey Creek plant site. Noranda would upgrade the Bear Creek Road (#278) and two other KNF roads (#2317 and #4781). Construction of these facilities and Noranda's proposed operating and reclamation plans are described in greater detail in the following sections.

Mine Plan

Noranda would develop an underground mine producing 20,000 tons of ore daily, or 7 million tons per year. A 230-kV transmission line would supply power. Current ore reserves are about 140 million tons at an average grade of 2.1 ounces of silver per ton and 0.78 percent (~15 pounds per ton) copper. These reserve estimates are based on a limited number of drill holes. The deposit has not been fully delineated and likely extends further north than the available drilling information indicates. Considering an expected ore extraction of 60 to 70 percent, waste rock dilution, and initial production rates, the mine is anticipated to have a production life of 16 years.

The ore body is composed of two, nearly parallel zones separated by about 30 feet of waste rock. The upper horizon averages about 30 feet thick; the lower averages about 34 feet thick. The ore body outcrops near the north end of Rock Lake, and dips at about 15° to the north and northwest.

Facilities associated with the mine would include a plant and two adits along Ramsey Creek, an adit along Libby Creek, two percolation pond areas along lower Ramsey Creek, a tailings impoundment in Little Cherry Creek and roads providing access to the facilities (Figure 2-3). Preproduction development would include drilling two parallel adits directly southwest of the plant site for a distance of about 13,000 feet. (Figure 2-4). The adits would include a main conveyor adit and a parallel main ventilation intake adit. The Ramsey Creek adits would terminate at an underground primary crusher. An additional 18,000-foot ventilation adit is currently being constructed from a private land site along Libby Creek (Noranda Minerals Corp., 1989). The purpose of the Libby Creek adit is to provide access to the ore body and to conduct geotechnical and geochemical investigations.

Adit portals are proposed outside the wilderness boundary. Portal patios would be constructed by cutting into the sideslope, creating a vertical face for adit construction. Adit size is dictated by ventilation requirements and mining equipment dimensions, with each adit estimated at about 26 feet wide by 26 feet high.

The adit at Libby Creek originates at about 4,000 feet elevation and slopes downward five percent over its 18,000-foot length. Adit construction began in the fall of 1989 under an exploration permit issued by the DSL. Prior to initiation of adit construction, suitable topsoil was salvaged and stockpiled. Additional facilities at the Libby Creek site include a waste rock storage area, a percolation pond, diversion ditches and settling ponds, and mine support buildings (Figure 2-5).

Other preproduction underground development would include excavation of the crusher station and related ore and waste rock bins, and development of main mining benches, haulage drifts, ore and waste passes. On-site diesel generators would power electric fans for ventilation to underground activities until the transmission line was built and operating. The transmission line, plant site, and initial tailings impoundment construction would also occur prior to production.

During the project, an estimated 4.15 million tons of waste rock would be excavated. The waste rock would be stored at the Libby Creek adit site or at the waste rock storage area (Figure 2-6). The flat-topped stockpile would be about 140 feet high. All waste rock produced during mining would either be placed in previously mined areas underground or sent to the surface for construction of surface facilities, primarily the plant site and the tailings impoundment dam. All waste rock would be

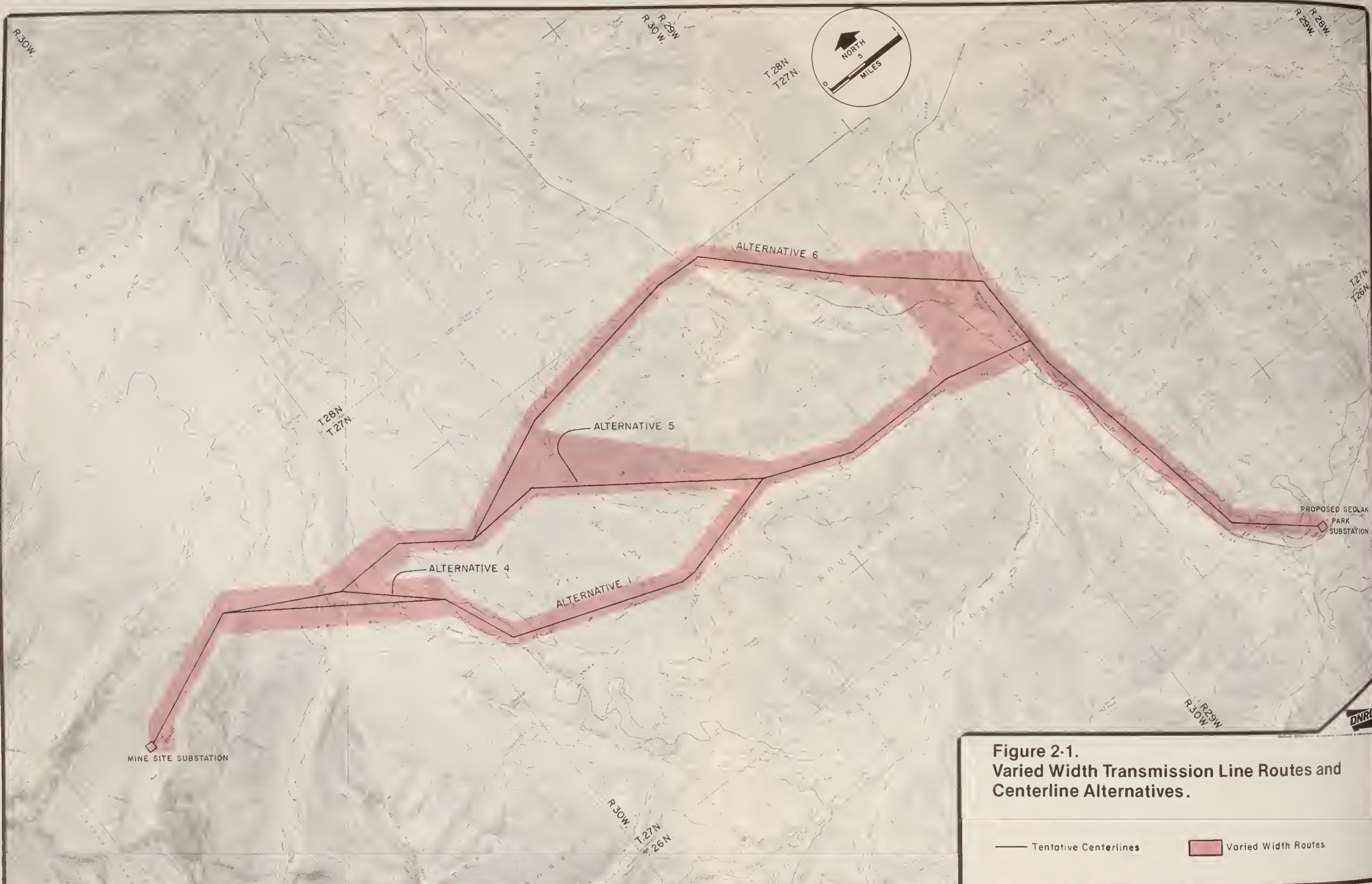


Figure 2-1.
Varied Width Transmission Line Routes and Centerline Alternatives.

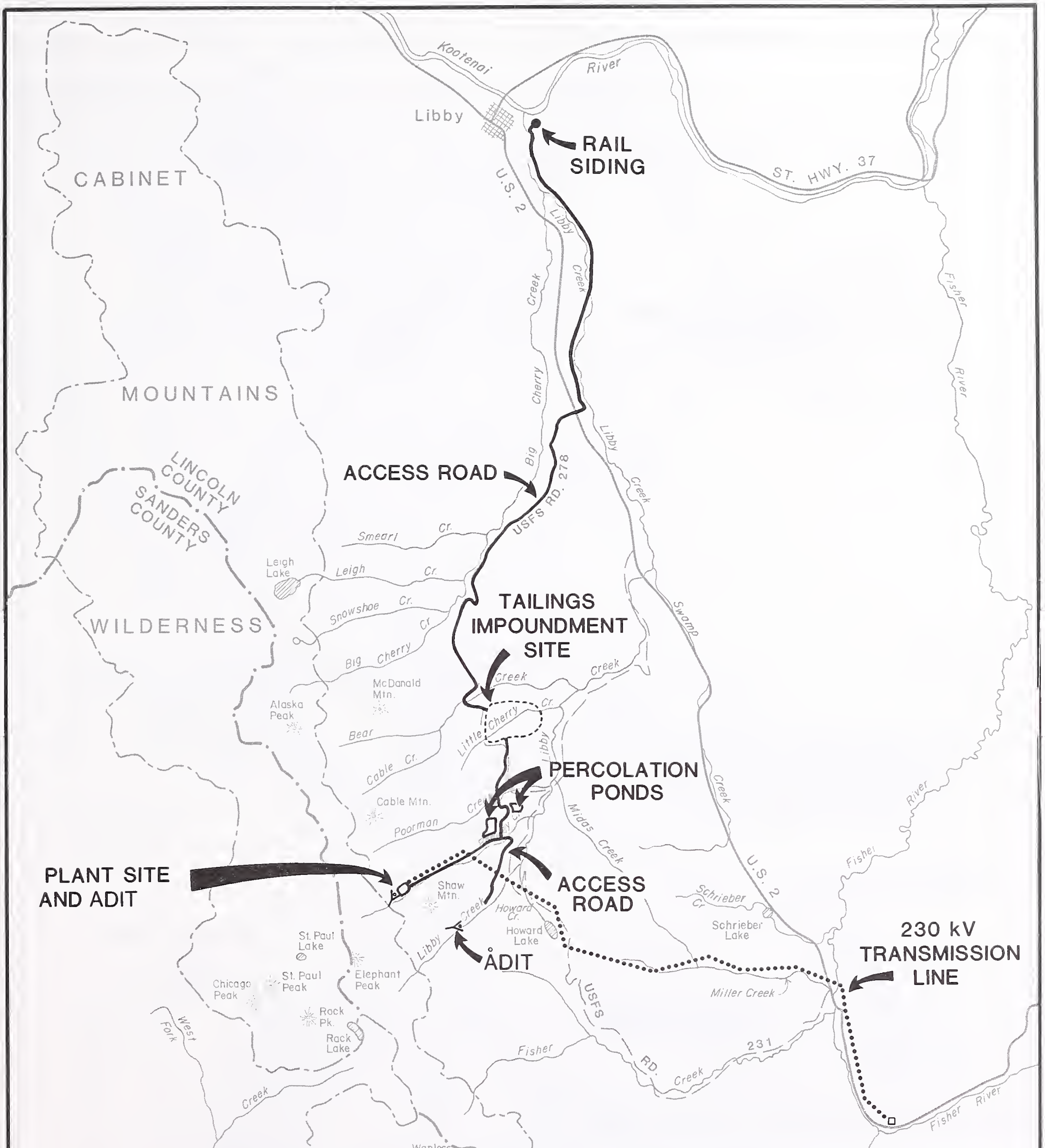


FIGURE 2-2.
PROPOSED LOCATION OF MONTANORE PROJECT FACILITIES

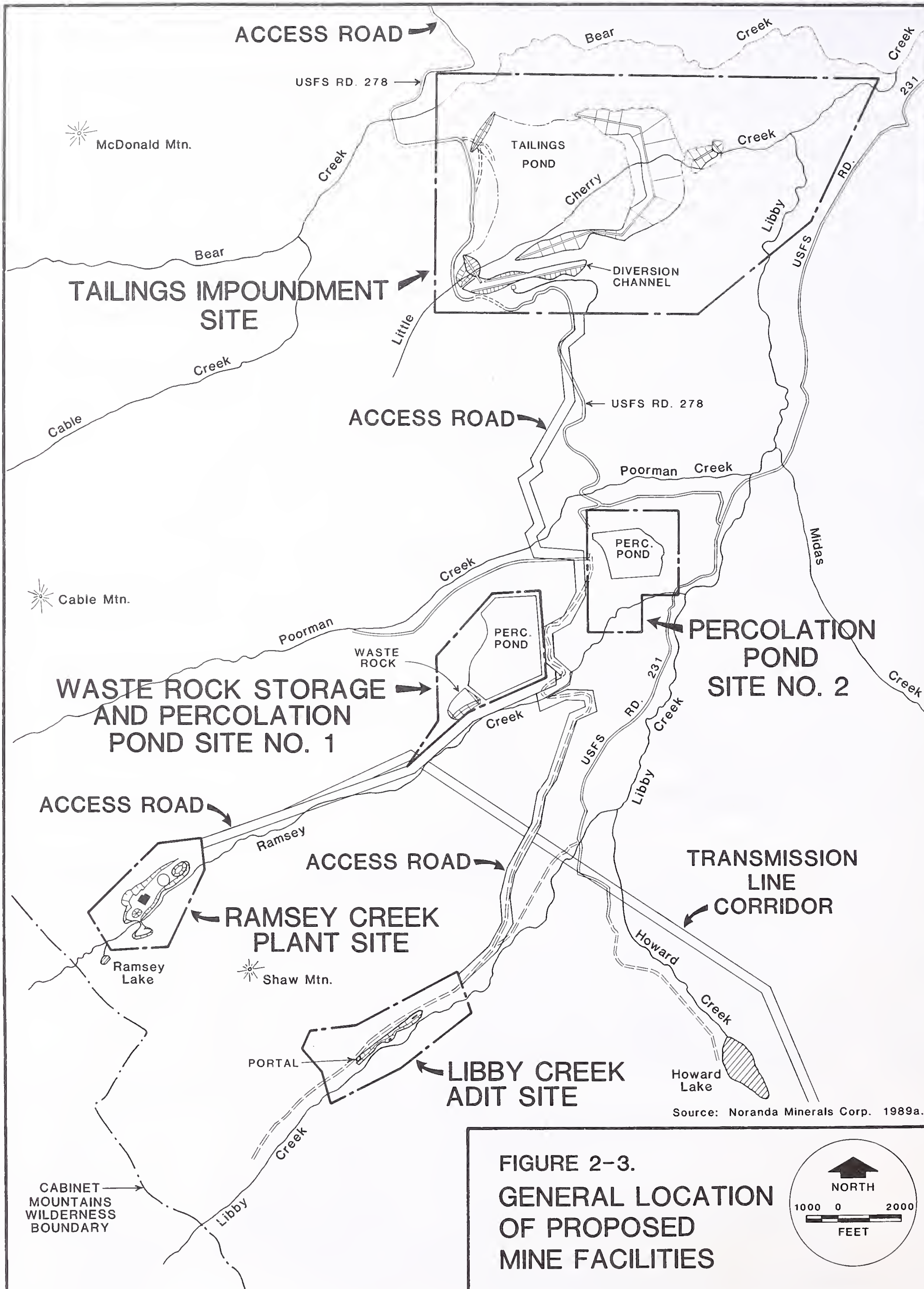
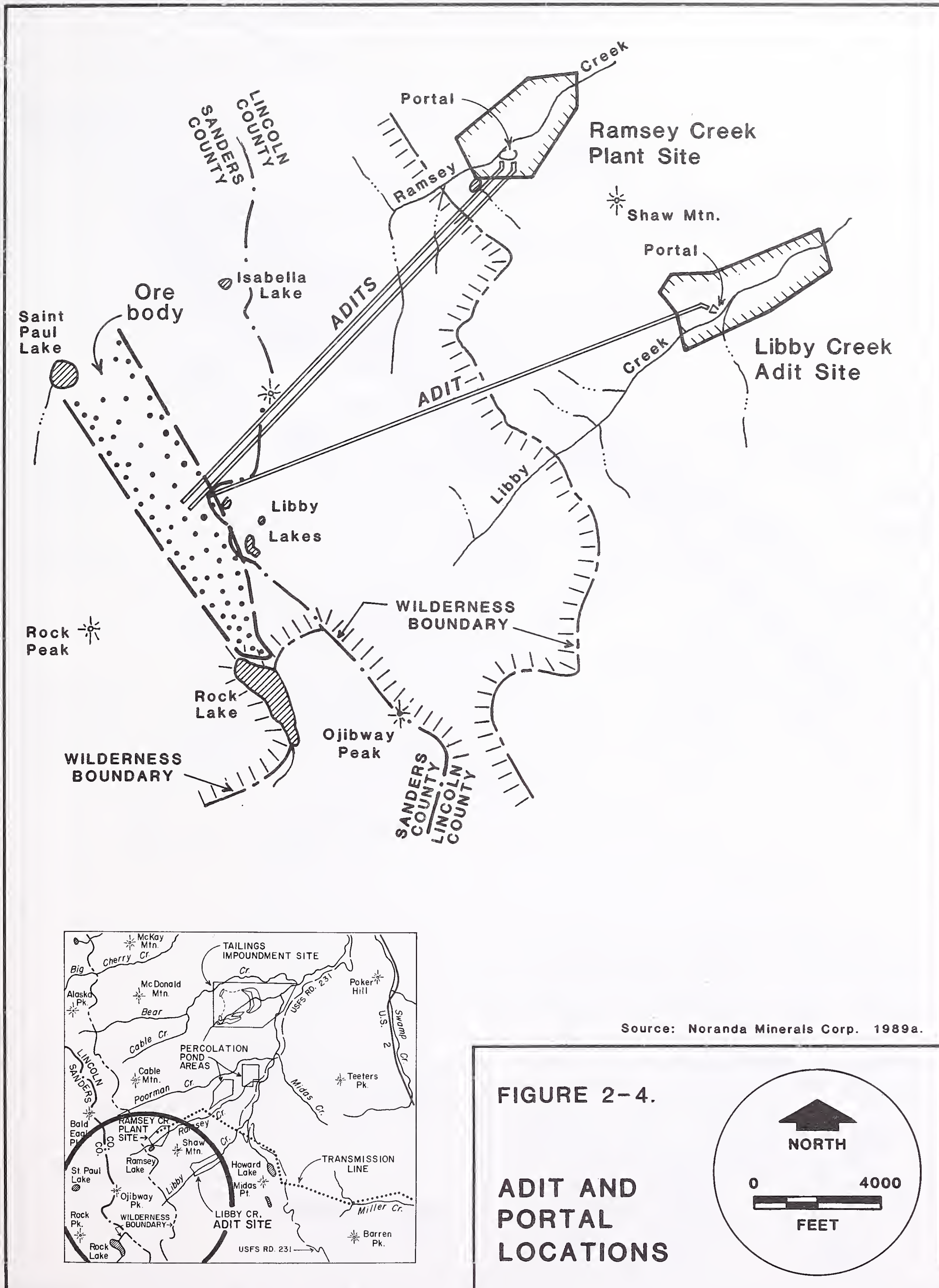


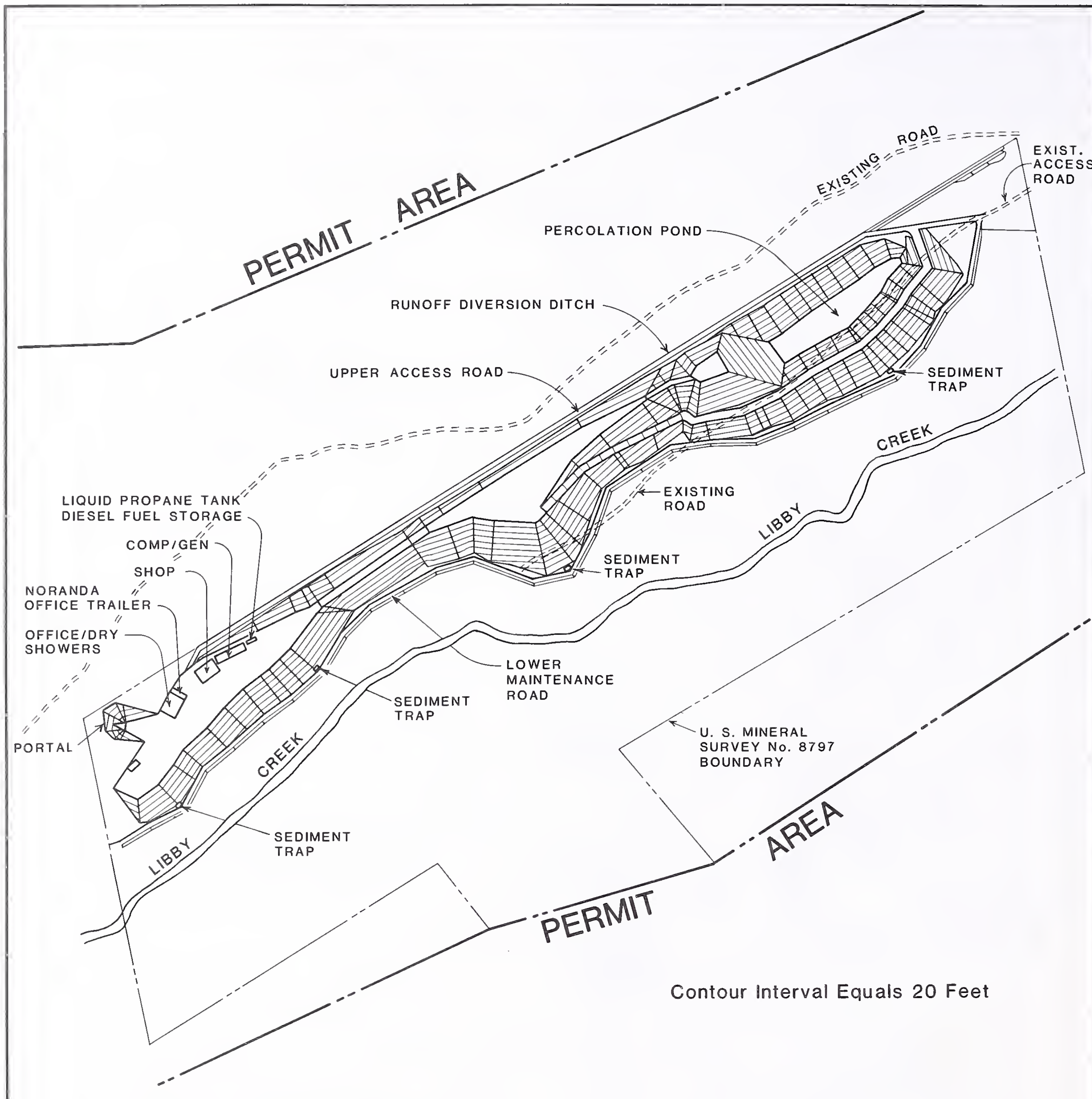
FIGURE 2-3.
GENERAL LOCATION OF PROPOSED MINE FACILITIES

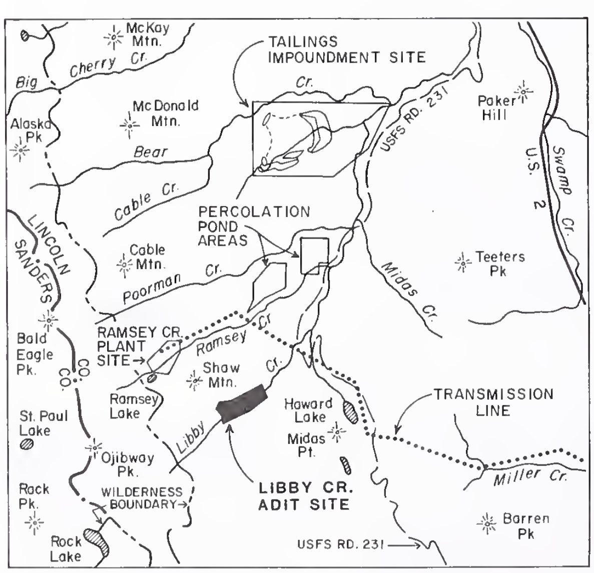


Source: Noranda Minerals Corp. 1989a.

FIGURE 2-4.

ADIT AND PORTAL LOCATIONS

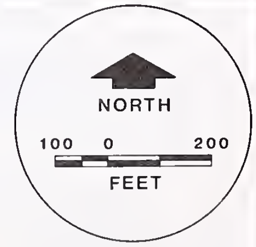


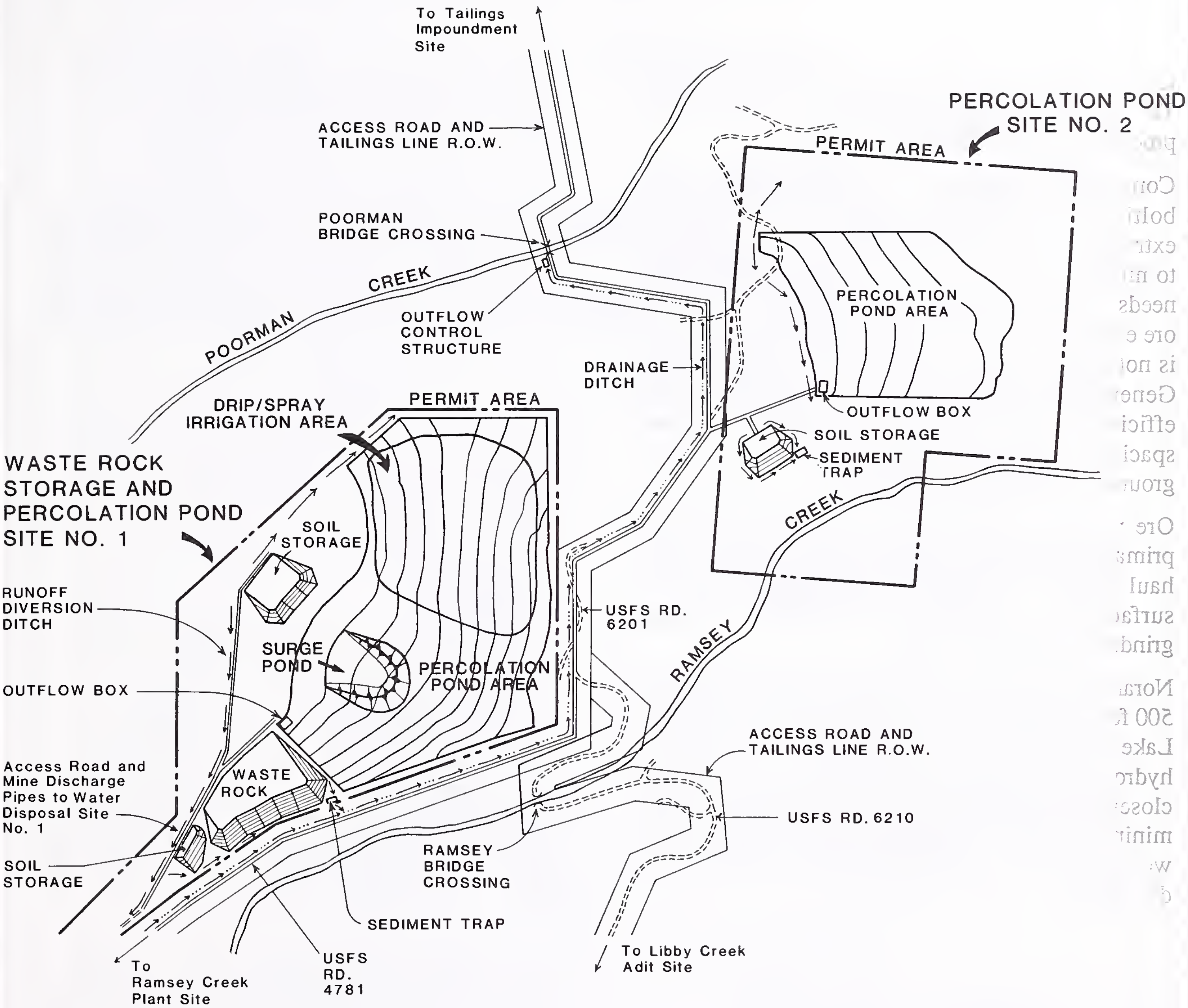


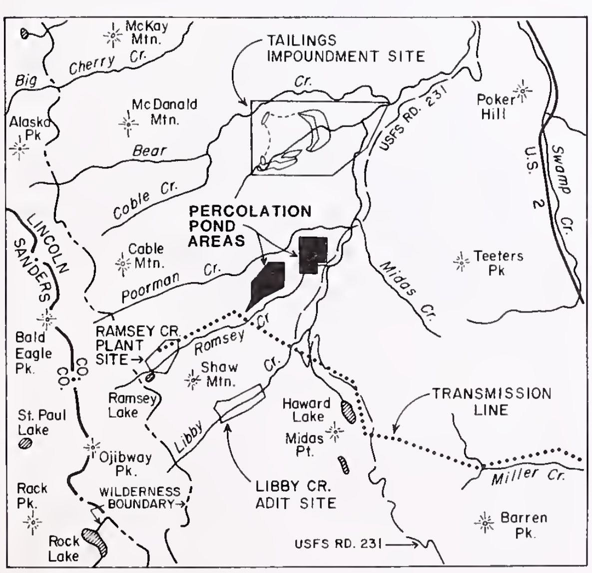
Source: Noranda Minerals Corp. 1989a.

FIGURE 2–5.

LIBBY CREEK ADIT SITE







Source: Noranda Minerals Corp. 1989a.

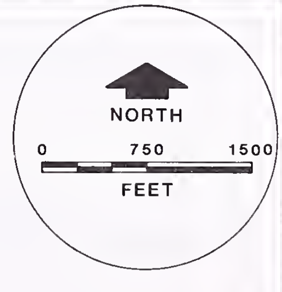


FIGURE 2-6.

WASTE ROCK STORAGE AND PERCOLATION POND AREAS

removed from the stockpile by the end of operations. Table 2-2 provides information on waste rock production and storage.

Conventional methods of drilling, blasting, rock bolting, and mucking would be used for ore extraction. Noranda would use electrical equipment to minimize underground emissions and ventilation needs. A room-and-pillar method would be used for ore extraction. In room-and-pillar mining, some ore is not mined to provide pillar support (Figure 2-7). Generally, a regular pattern of pillars is more efficient than an irregular one, with the size and spacing of pillars varying and dependent on local ground conditions.

Ore would be hauled from the ore passes to the primary underground crusher using 39-ton electric haul trucks. Crushed ore would be sent to the surface via conveyor belt for further crushing, grinding, and ore recovery.

Noranda proposes to maintain a minimum distance of 500 feet from Rock Lake and 100 feet from the Rock Lake fault (Figure 2-8). Noranda would conduct hydrologic and geotechnical studies prior to mining closer to these two features to determine if closer mining could be safely conducted. These studies would consist of drilling into the fault zone to determine—

Table 2-2. Waste rock production and storage.

Facility	Amount (in million tons)	Storage area
Libby Creek adit	1.45	Tailings impoundment
Ramsey Creek adits	1.10	Tailings impoundment†
Mine development	1.60	Inside mine
Total	4.15	

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-29-a.

†Would be stored in waste rock storage areas prior to use.

- hydraulic conductivities and transmissivities for the fault zone and adjacent transition zones;
- width of the fault and transition zones; and
- water pressures in the fault and transition zones.

The present mine plan is conceptual and based on a limited number of drill holes. Additional hydrologic and geotechnical information will be obtained from tests conducted underground following completion of the Libby Creek evaluation adit.

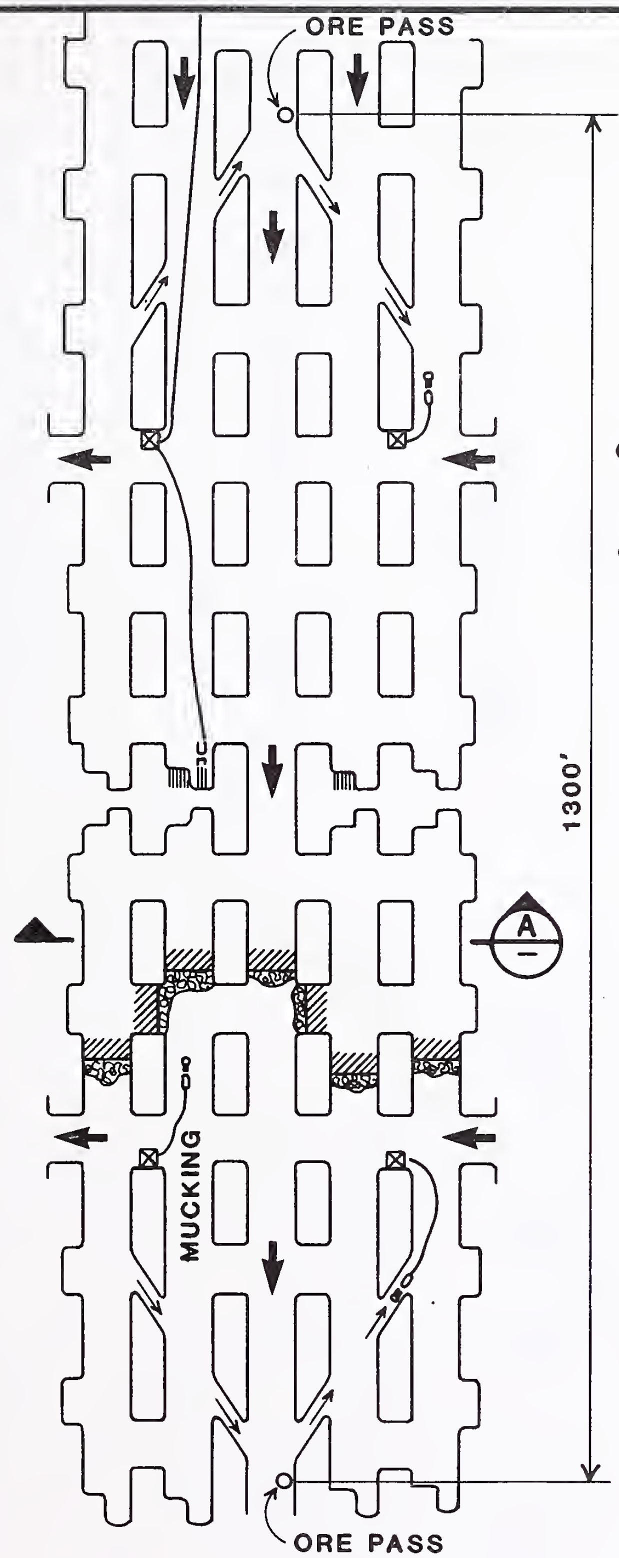
Ore Processing and Shipment

The mill would be constructed adjacent to Ramsey Creek and consist of—

- a mill concentrator;
- a tailings thickener;
- drainage sumps;
- attendant pumps;
- slurry and water lines;
- an office building, and
- changing house, and shop warehouse (Figure 2-9).

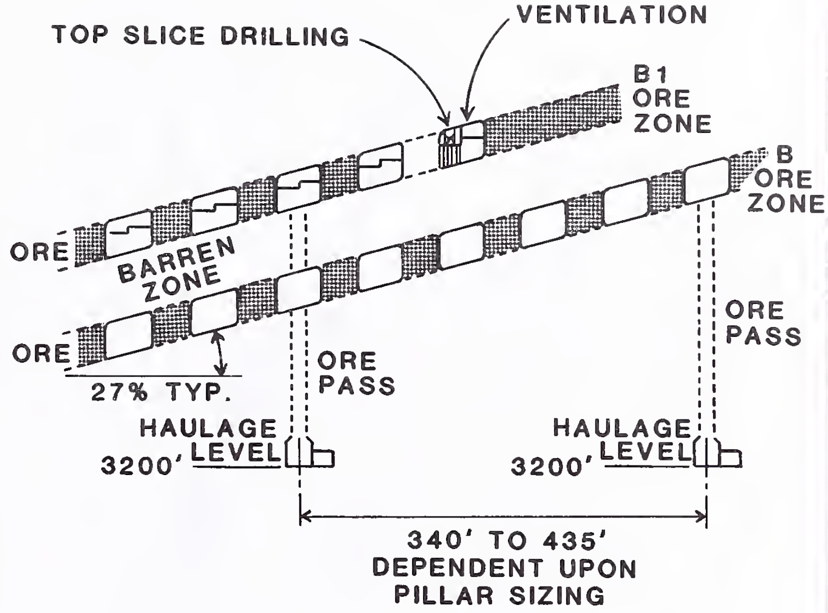
Gasoline and diesel fuel would be stored in two above-ground storage tanks. A containment berm would be built around the tanks. Noranda has prepared a spill prevention control and containment plan.

The mill would operate 7 days a week, 350 days a year for a total processing capacity of 7 million tons per year. The milling process would involve five major steps—crushing, grinding, flotation, concentrate dewatering, and tailings storage. Figure 2-10 illustrates the steps used in ore processing. Crushing, grinding, and flotation would produce both copper and silver concentrate, and waste tailings. Chemical reagents added during the flotation process would separate concentrated metals from the tailings (Table 2-3). Some reagents would be disposed in the tailings impoundment and some would remain in the ore concentrate.



PLAN VIEW

SCALE: 1" = 200'



CROSS SECTION (A)

SCALE: 1" = 200'

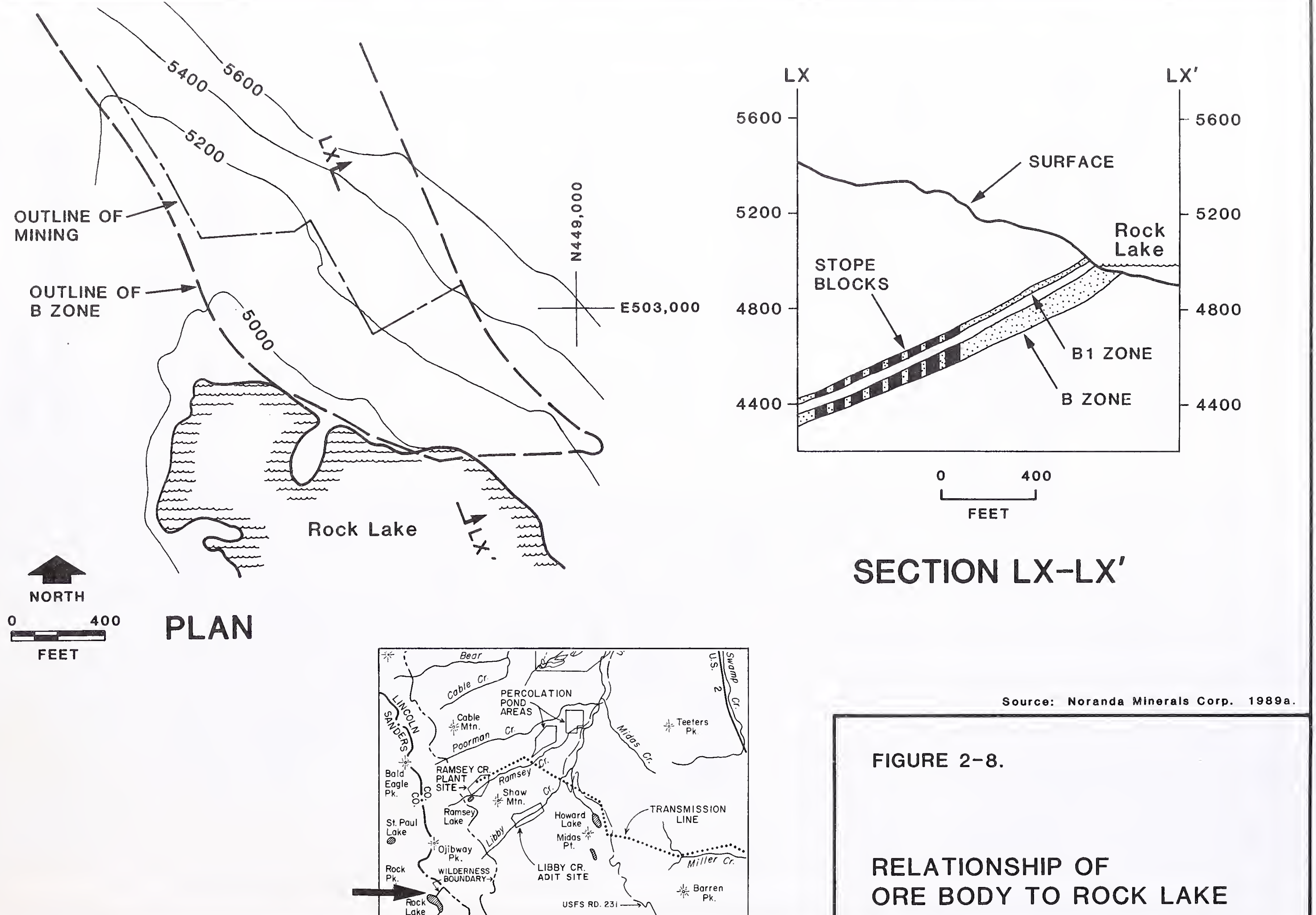
LEGEND

- INDICATES RAMP @ +15%
- VENTILATION
- POWER CENTER
- BENCH
- PILLAR

Source: Noranda Minerals Corp. 1989a.

FIGURE 2-7.

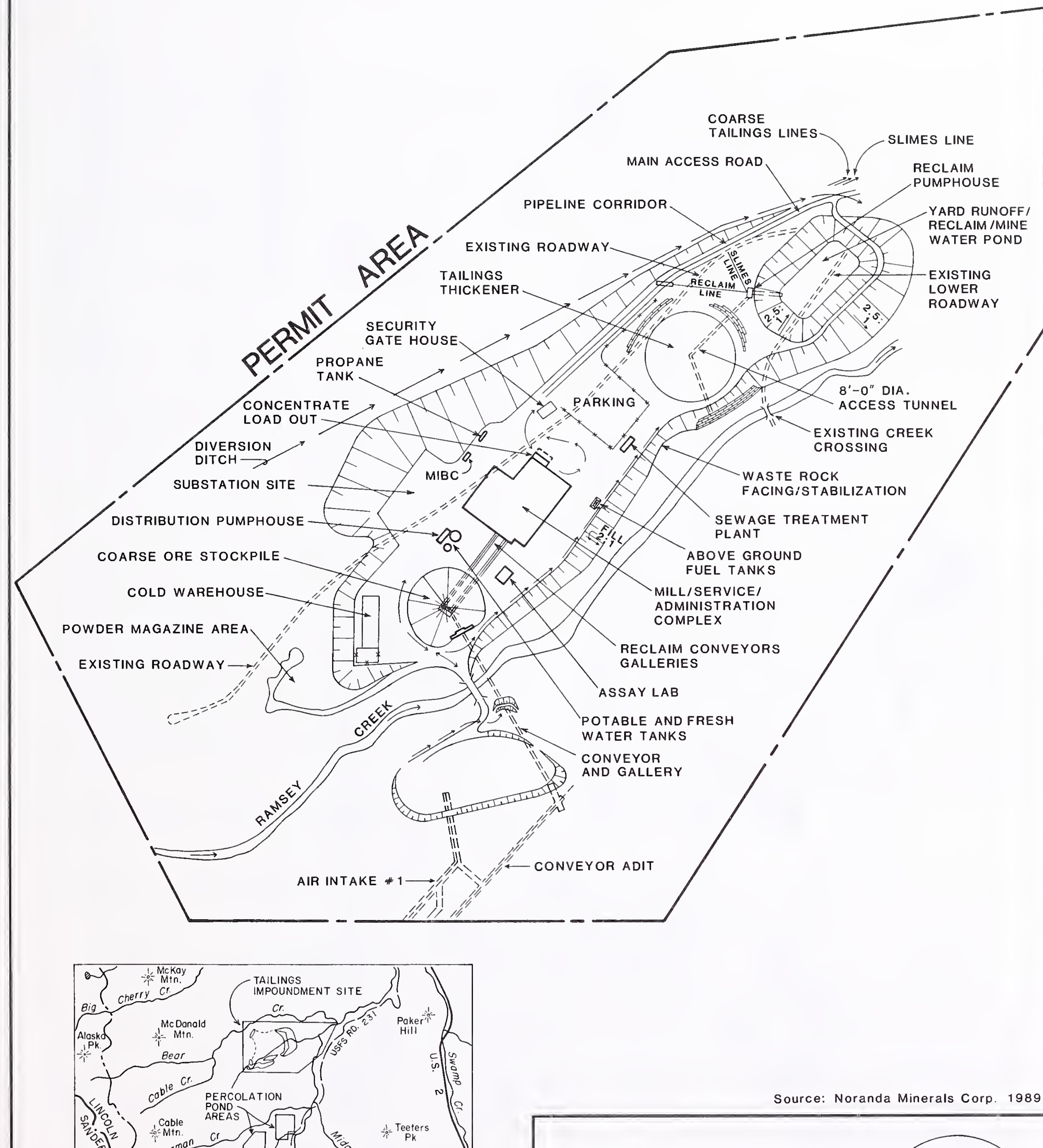
ROOM-AND-PILLAR MINING



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-8.

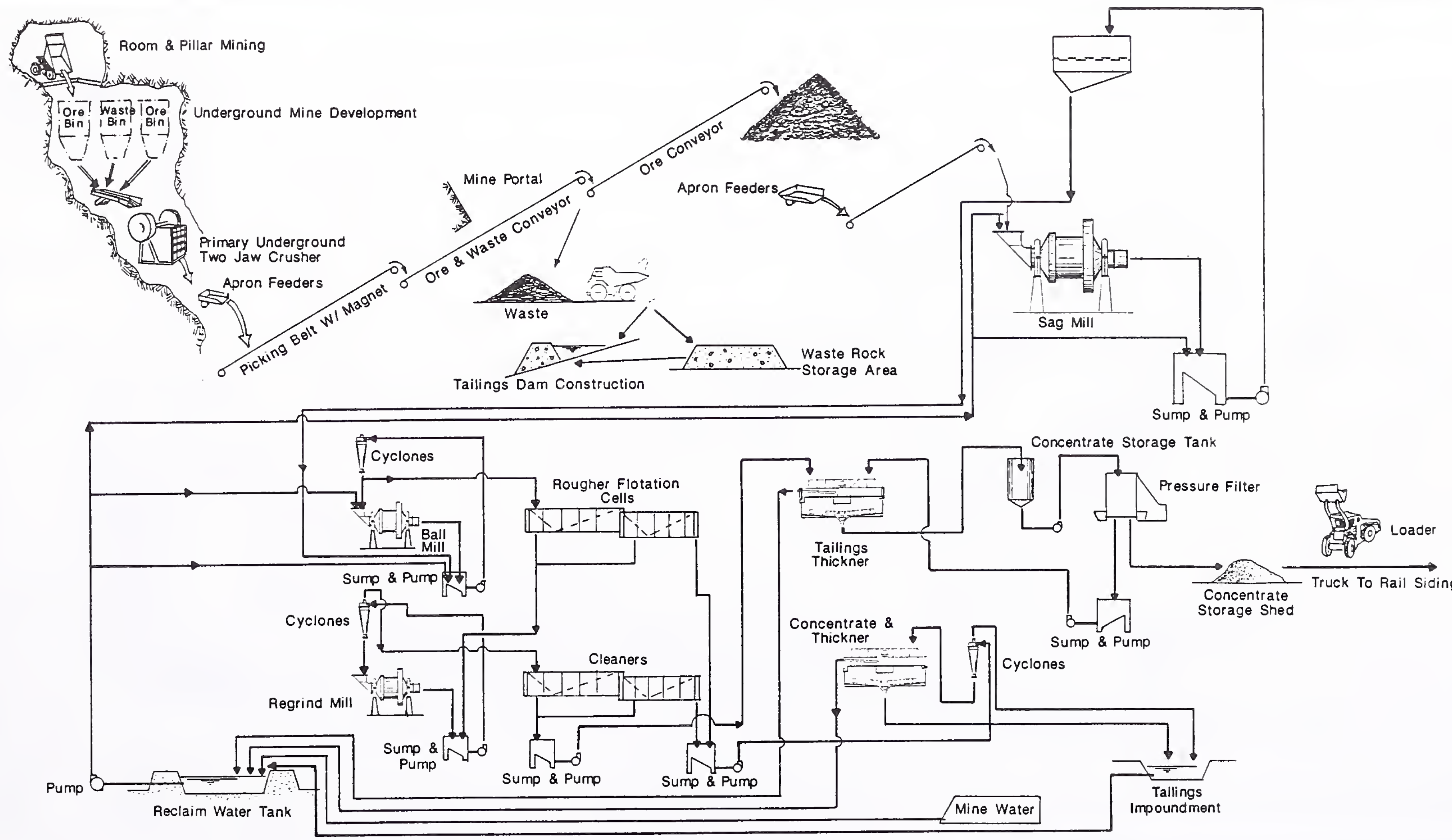
RELATIONSHIP OF ORE BODY TO ROCK LAKE



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-9.

RAMSEY CREEK PLANT SITE



Source: Noranda Minerals Corp. 1989a.

FIGURE 2–10.

MINING AND MILLING FLOWSHEET

Concentrates leaving the flotation process would be pumped to a 60-foot diameter concentrate thickener where a portion of water would be removed for reuse in the mill. After further dewatering, concentrates would be deposited in a shed and then loaded into haul trucks by a front-end loader. About 420 tons of concentrate would be trucked daily to a railroad siding one mile east of Libby via USFS Road 278 and a haul road owned by Champion International Corp.

Tailings Storage

Tailings would be separated at the mill into coarse-textured (sand) and fine-textured (slime) fractions. The sands would flow by gravity through a 10-inch high-density polyethylene pipe to the tailings impoundment, where they would be used in dam construction. As a backup, an auxiliary coarse tailings line to the impoundment would be constructed.

The slimes would flow to a thickener just east of the plant. Thickener overflow (water) would be diverted to a small surface pond (see Water Use and Management). Slimes and water would flow via a 14-inch, high-density, polyethylene pipe to the tailings impoundment for disposal. All lines would be routed in part along the existing road. A new road would be constructed along portions of pipeline that diverge from the existing road.

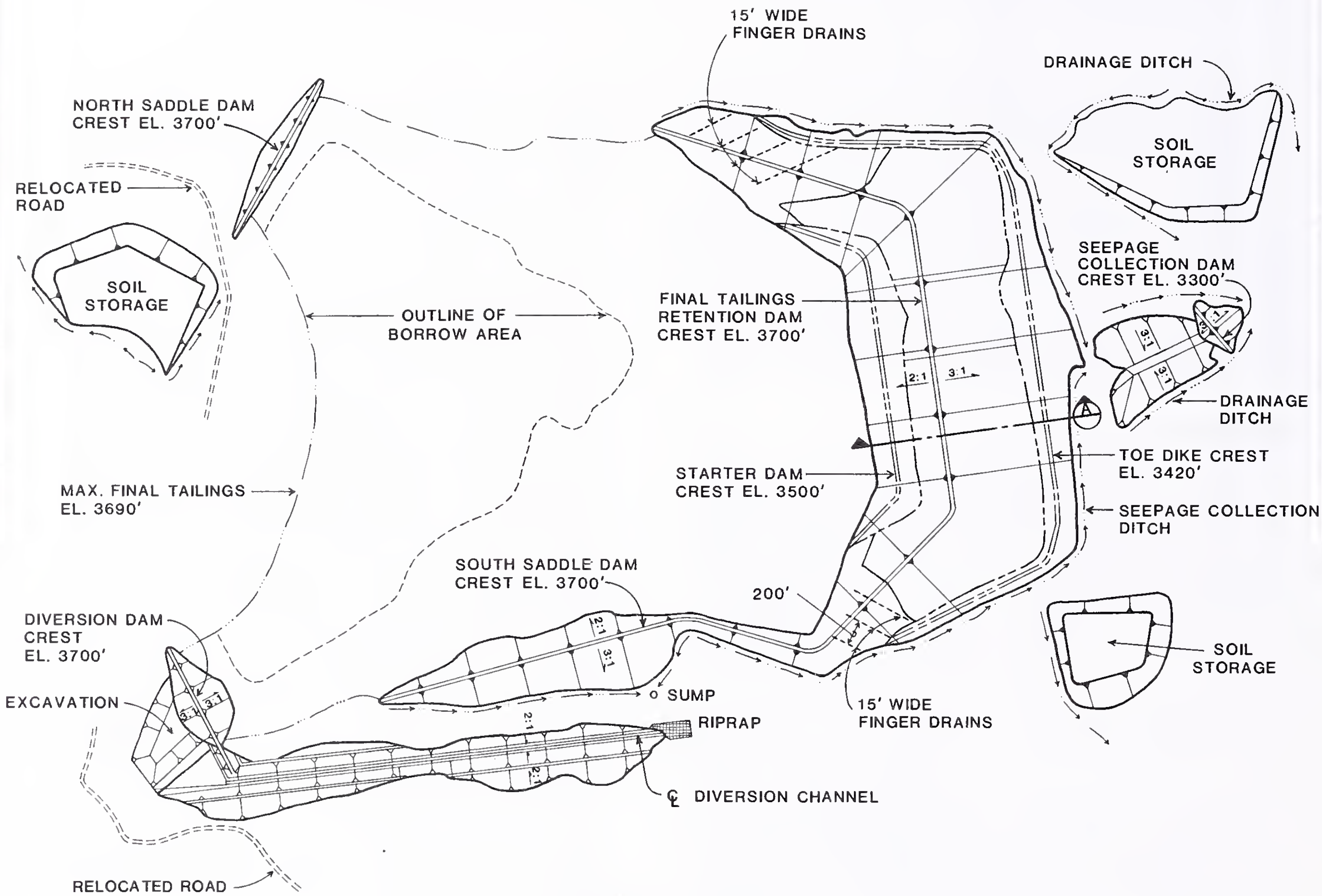
Noranda has designed a number of measures to prevent or mitigate ruptures in the tailings pipelines. Noranda would construct a second (backup) sand line to use in the event that the first line becomes significantly eroded. An automated leakage sensing system would continuously monitor line operation. If the system detects a leak, the mill and tailings transfer would shut down. The pipelines between the mill and the tailings impoundment would be visually inspected each shift. An additional inspection would take place during scheduled maintenance shutdowns. A ditch paralleling the entire length of the pipelines would contain and transport any discharged tailings to the tailings impoundment. Containment and surface water runoff ditches would be constructed with an earthen berm between them. This berm would ensure that in the event of a rupture, all tailings would remain in ditch and not come in contact with surface waters. Where the pipelines cross Poorman Creek, a lined flume and trestle would be constructed.

The proposed tailings impoundment area is about five miles northeast of the plant site, in the Little Cherry Creek watershed. The impoundment dam (embankment) would be constructed in stages over the 16-year period. The dam would eventually be built to about 380 feet in height, with a dam crest elevation of 3,700 feet (Figure 2-11). About 100 million tons of tailings would be stored in the impoundment. The impoundment site is capable of holding 120 million tons.

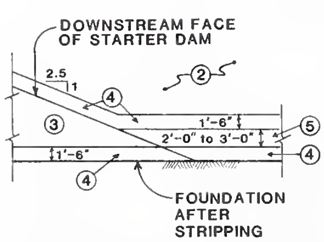
Table 2-3. Description of reagents.

Reagent	Purpose	Addition point	Consumption: Pounds per ton ore	Consumption: Pounds per year	Storage
Potassium Amyl Xanthate	Collector	Ball mills Regrind mills Flotation cells	.04	280,000	250 lb. drums
MIBC	Frother	Flotation cells	.02	140,000	9,000 gal. tank
Percol 352	Flocculant	Concentrate and tailings thickener	.02	140,000	50 lb. bags

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-54.

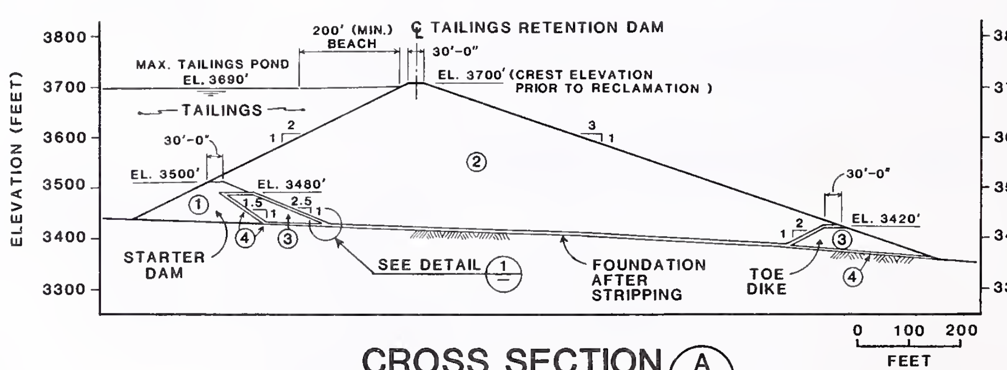


SITE PLAN



DETAIL 1

NOT TO SCALE



CROSS SECTION A

ZONE	DESCRIPTION
1	EARTHFILL ON-SITE
2	CYCLONED SAND
3	ROCKFILL (MINE WASTE OR QUARRY)
4	FILTER (SAND)
5	BLANKET DRAIN (GRAVEL)

Source: Noranda Minerals Corp. 1989a.

FIGURE 2-11.

TAILINGS IMPOUNDMENT SITE

Noranda has developed general final design criteria for tailings dam stability, diversion channel design, dam and dike design, and tailings settlement in cooperation with the agencies. These criteria are described briefly in this section and in greater detail in Chapter 6–Methods. Noranda would follow stability criteria recommended by the U.S. Corps of Engineers. Noranda would also consider the effects of earthquakes in dam stability. The Maximum Credible Earthquake event (see Glossary) would be used in stability analyses. Noranda would use estimated runoff from the 24-hour general storm Probable Maximum Precipitation event for sizing containment requirements in the tailings impoundment. Since the tailings impoundment would occur in a small watershed, and the 6-hour local storm Probable Maximum Precipitation event for sizing diversion requirements.

During final design, Noranda would estimate the amount of tailings settlement using conventional methods. The estimate would be used to design the final reclaimed pond surface configuration and to estimate the amount of required earthwork.

The impoundment area would consist of several structures, including the tailings retention dam (which would include a starter dam and a toe dike); a diversion dam; two earth-filled saddle dams; a seepage collection dam; and a diversion channel. Construction of the diversion channel for Little Cherry Creek and an 85-foot high diversion dam would be concurrent with vegetation clearing for the tailings impoundment. After the diversion dam is complete, the starter dam, seepage collection dam, and toe dike would be built. Excavated channel material would be used to construct the diversion dam and the starter dam; any remaining material from the excavation would be used to construct a portion of the south saddle dam. The remaining portion of the south saddle dam and the north saddle dam would be constructed with borrow area materials and mine waste rock. To supplement materials excavated during diversion channel construction, about 1.3 million cubic yards of material would be excavated from a borrow area within the proposed impoundment area (Figure 2-11). The tailings impoundment and associated structures would disturb about 729 acres. Noranda is conducting studies to determine the quantity and quality of available borrow material in the tailings impoundment area.

Prior to impoundment construction, the site would be cleared of vegetation and stripped of soils suitable for reclamation. The ground surface would be scarified and compacted before dam construction. Any sandy or gravelly soils exposed during excavation operations would be covered with a 2- to 3-foot thick layer of compacted clay to minimize water infiltration from the tailings impoundment or from the seepage collection pond.

A permanent diversion system would be constructed at the impoundment site to route Little Cherry Creek around the impoundment. The diversion channel would be 3,400 feet long and would have a bottom width of 20 feet. The channel sides would be protected from erosion by a 3-foot layer of rock riprap. At the end of operations, rockfilled bars would be placed perpendicular to the natural stream channel below the diversion channel to provide energy dissipation and protect against erosion. To minimize runoff from the impoundment area, diversion ditches would be built around the impoundment site to intercept and divert water away from the impoundment site.

During operations, horizontal seepage through the dam and surface water runoff would be intercepted with a downstream collection and containment system. Seepage water passing through the tailings dam would be collected by ditches and routed to a seepage collection pond. Water from the seepage collection pond, estimated to be 700 gpm, would be pumped back to the tailings impoundment.

A rock-filled toe dike would be constructed upstream of the seepage collection ditches during the impoundment's operational life. The toe dike would intercept tailings washed from the downstream dam

face. Sand and gravel filters would be placed on the toe dike upstream face to prevent tailings from passing through the dike.

As the dam is raised, impoundment seepage would be controlled through a blanket drain. The drain would extend from the downstream face of the starter dam to the toe dike. The drain would consist of layers of gravel three feet thick in the valley bottom decreasing in thickness to two feet at higher elevations. To prevent piping of the tailings and foundations soils into the gravel drain, 1.5-foot thick sand filter blankets would be located both above and below the blanket drain (Figure 2-11). The drain and filter materials would be imported from commercial sources near Libby or processed from quarried rock or mine waste rock.

Artesian ground water conditions occur at the proposed impoundment site. To relieve the upward pressure caused by these conditions and to provide dam stability, Noranda has proposed a pressure relief system. The system would also collect seepage that has entered the ground water underlying the impoundment. The system is described in greater detail in the following section.

Water Use and Management

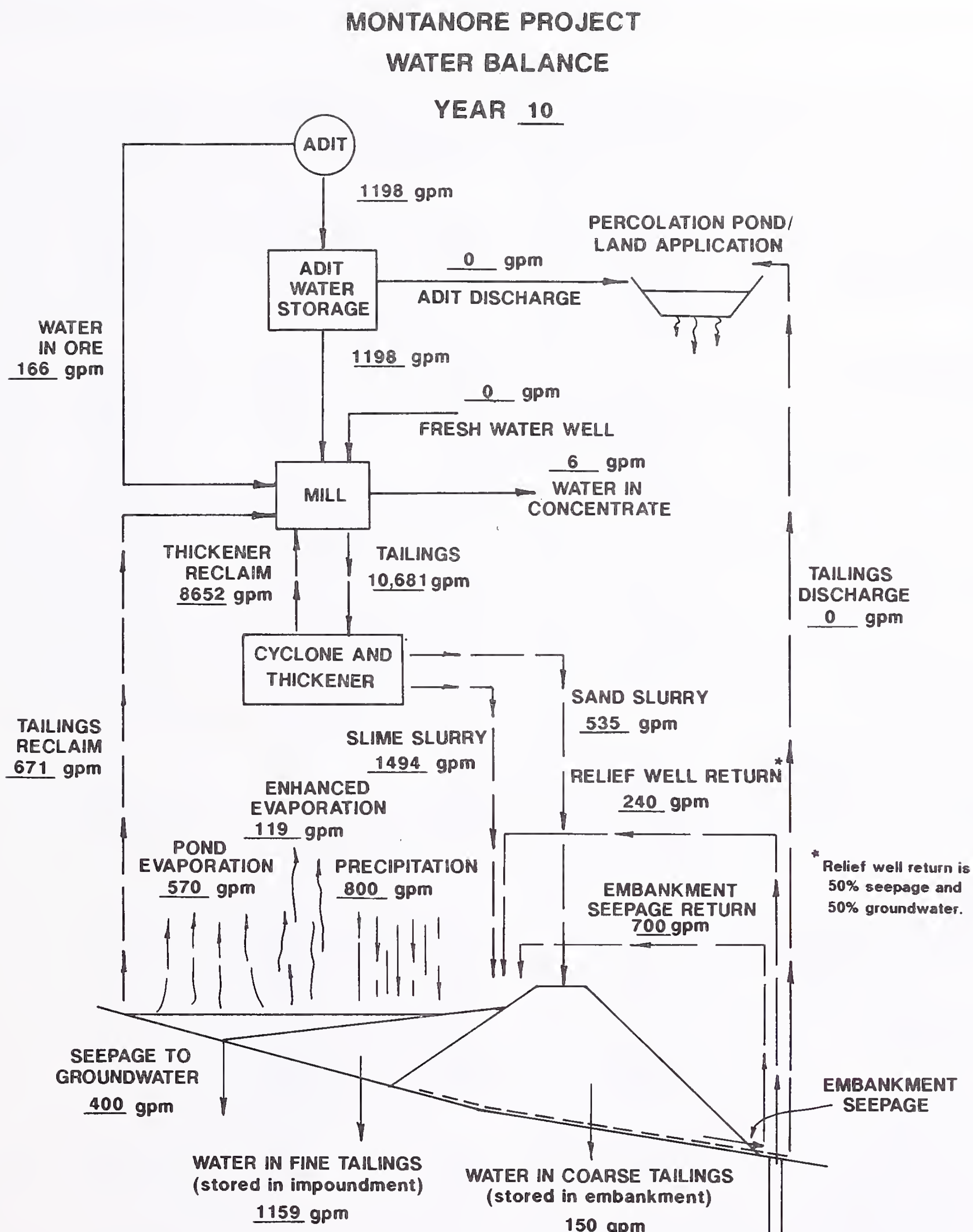
During full production, the mill would require 10,687 gallons per minute (gpm) of water (Figure 2-12; Table 2-4). Most of this water would be reclaimed from either the tailings thickener or pumped from the tailings impoundment. Noranda has estimated that 1,198 gpm would be available from mine water. A portion of this water would be diverted to collection sumps for settling and storage for later use. The balance of the water would be pumped to the surface for use in the milling process.

During mill operation, additional water would be required to supplement mine water and reclaimed water and to provide potable water. Noranda has identified two possible sources of fresh water, wells or surface water from either Ramsey Creek or Libby Creek. Noranda anticipates the additional water could be provided by alluvial wells in Ramsey Creek or Libby Creek. Wells would probably be between 100 and 150 feet deep. Surface water diversion would only be required if wells could not adequately supply the necessary water. Noranda would acquire all necessary water rights and permits before any such diversion would take place.

Noranda would use three water disposal areas to discharge excess water. One area is located near the Libby Creek adit and two would be in lower Ramsey Creek (Figure 2-6). These disposal areas would consist of a combination of percolation ponds, infiltration trenches, or land irrigation.

Concurrent with the Ramsey Creek adit construction, Noranda would construct a small (10 acres) percolation/surge pond system at percolation pond site no. 1. Vegetation would be removed from the disturbed area prior to topsoil salvage. Noranda estimates about 58 acres of disturbance (ponds, embankments, access roads and ditches) would occur at site no. 1. A drip/spray irrigation system would be installed over an area of about 50 acres. The irrigation area would require only selective tree thinning, access road construction and little topsoil salvage. This system would be used to discharge water encountered during adit construction.

Expansion of the water disposal areas would be gradually increased to reflect the increasing quantity of water encountered during adit construction. Noranda estimates the percolation pond area may require 30 acres or more of disturbance. The final size of the water disposal area would be dependent on the quantity of water entering the mine (mine inflow), precipitation, and evaporation. The entire percolation pond permit areas (472 acres) would not be disturbed unless mine inflows are considerably greater than Noranda estimated. After the tailings impoundment is constructed, Noranda anticipates using the water disposal areas infrequently and for short periods.



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-12.

PROJECT WATER BALANCE

Table 2-4. Average process water balance—Years 1, 5, 10 and 16.

Source	Year 1	Year 5	Year 10	Year 16
	gallons per minute			
Adit discharge				
Total discharge	1,198	1,198	1,198	1,198
Discharge to percolation ponds	69	0	0	0
Net discharge to mill	1,129	1,198	1,198	1,198
Mill inflow				
Net discharge from adit	1,129	1,198	1,198	1,198
Fresh water wells	0	61	0	0
Water in ore	166	166	166	166
From thickener	8,652	8,652	8,652	8,652
From tailings impoundment	740	610	671	671
Subtotal	10,687	10,687	10,687	10,687
Mill outflow				
Tailings to thickener	10,681	10,681	10,681	10,681
Water in concentrate	6	6	6	6
Subtotal	10,687	10,687	10,687	10,687
Thickener inflow				
Tailings from mill	10,681	10,681	10,681	10,681
Thickener outflow				
Coarse tailings to impoundment	535	535	535	535
Fine tailings to impoundment	1,494	1,494	1,494	1,494
To mill	8,652	8,652	8,652	8,652
Subtotal	10,681	10,681	10,681	10,681
Tailings pond inflow				
Precipitation	260	590	800	1,020
Coarse tailings from thickener	535	535	535	535
Fine tailings from thickener	1,494	1,494	1,494	1,494
Embankment seepage return	700	700	700	700
Seepage interception/ relief well return	0	20	240	390
Subtotal	2,989	3,339	3,769	4,139
Tailings pond outflow				
Enhanced evaporation	0	10	119	254
Natural evaporation	190	420	570	730
Water in coarse tailings (stored in embankment)	150	150	150	150
Water in fine tailings (stored in impoundment)	1,159	1,159	1,159	1,159
Seepage into ground water	50	290	400	475
Seepage through embankment	700	700	700	700
Discharge to percolation ponds	0	0	0	0
To mill	740	610	671	671
Subtotal	2,989	3,339	3,769	4,139

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-130.

In developing the project water balance, Noranda estimates that discharge of excess water would be required only in the first few years of operations (Table 2-4). Noranda would maintain a detailed water balance which would be used to monitor water use. Noranda has developed contingency plans for handling excess mine inflow or excess tailings water. If sustained mine inflows greater than 1,200 gpm or excess tailings water occurs, Noranda would notify the agencies, evaluate alternatives to handle the excess water, and would then initiate appropriate action.

Possible water control alternatives include grouting of fractures and joints to reduce ground water inflows, discharge of segregated clean mine water to surface or ground water, temporary storage in the tailings impoundment coupled with enhanced evaporation, or diversion of water around the tailings impoundment using temporary diversion ditches. These techniques are briefly discussed in the the following sections.

Grouting. The bedrock which would be encountered by the adits and mine is essentially impermeable. Several large faults and smaller fractures potentially capable of storing and transmitting ground water would be encountered during mine development (see Geology and Ground Water Hydrology sections in Chapter 3). To reduce the amount of water entering the adits and mining areas, Noranda would grout areas where water is flowing into the mine workings. Noranda estimates grouting could provide a reduction of 80 to 90 percent in the quantity of mine inflow. Noranda also proposes to drill in advance of the working face of the adits or mine areas to determine if saturated zones are present. Grouting would be the primary mechanism to reduce mine inflows.

Water segregation. Regardless of the amount of grouting, some mine inflow water would occur. Noranda would use 1,198 gpm of mine inflow water in ore processing. If additional water is encountered, Noranda would segregate "clean" ground water from water affected by mining operations. An array of holes would be drilled into a water-producing zone and the water directed to a collector pipe. Depending on the quality, Noranda would discharge this water either to Ramsey Creek or Libby Creek, or to the percolation ponds. Prior to discharge either to Ramsey Creek or Libby Creek, Noranda would obtain a Montana Pollutant Discharge Elimination System (MPDES) permit.

Tailings impoundment storage/enhanced evaporation. The tailings impoundment would serve as a water storage structure. Water would enter the impoundment from the tailings slurry, the seepage interception system, precipitation, and surface water runoff. Some water in the impoundment would either seep into the underlying ground water or seep through the tailings embankment. Water in the impoundment would also evaporate. As the impoundment increases in size, the amount of seepage would increase, reaching an estimated 475 gpm in Year 16 and decreasing following reclamation.

Noranda has proposed a pressure relief/seepage interception system which would collect tailings impoundment seepage after it has entered the ground water underlying the impoundment. Noranda would install closely-spaced wells along the toe of the tailings dam. Noranda's initial design proposes a passive well system; the wells would not be equipped with pumps. The number of wells necessary would be evaluated during the first several years of operation when interception of impoundment seepage is not proposed (Table 2-4). Noranda estimates that each well would capture two to three gpm; during Year 16, up to 110 wells may be installed. In addition to collecting tailings water seepage, the pressure relief/seepage interception system would intercept some ground water. Noranda estimates that 50 percent of the total volume of water intercepted would be ground water and 50 percent would be tailings water seepage. The intercepted water would be pumped back into the tailings impoundment, reaching a total of 390 gpm in Year 16.

To dispose of the additional intercepted ground water, Noranda has proposed an enhanced evaporation system, consisting of additional spray irrigation either at the percolation pond areas or on the impoundment surface. The percolation pond areas would only be used infrequently and for short periods of time. The spray irrigation system would be adjusted to achieve different evaporation rates. In Year 16 of operations, 254 gpm of tailings water would be evaporated using such a system. Noranda has assumed no additional discharge to ground water would result from the spray irrigation (Table 2-4).

Noranda is committed to controlling the amount of seepage and excess water discharge to the extent necessary to maintain water quality standards in surface and ground waters. This may require installation of additional wells, installation of well pumps, installation of impoundment drains or the installation of an interception trench down gradient of the impoundment.

In the event that the water balance shows a surplus, Noranda may construct temporary diversion ditches within the impoundment area, but above the expanding tailings pond. These ditches would divert surface runoff from undisturbed lands within the tailings impoundment perimeter into Little Cherry Creek, reducing the amount of water entering the tailings impoundment.

Surface Water Control

Surface water from the plant site would be directed to a collection ditch on the south side of the plant site. The water would then flow by gravity to a sediment pond sized to accommodate a 24-hour, 100-year storm event, four hours retention of the thickener overflow, and freeboard (distance from surface of a pond to top of a dam).

An interceptor ditch would be constructed on the plant's north side to divert surface runoff from undisturbed areas upstream of the plant site. The flow would then pass through culverts at the main access road and discharge into Ramsey Creek.

Noranda would be responsible for snow removal from all access roads and the plant site. Snow removal would follow Forest Service guidelines. Snow and ice removed from the plant site would be disposed at the percolation ponds. All debris removed from the road surfaces except snow and ice would be deposited away from the stream channels. Culverts would be kept free of snow, ice and debris.

Waste Management

During the initial development phase, portable facilities, such as Porta-Potties, may be used to handle sanitary wastes. As an alternative, a septic tank and drainfield may be used. During the operating phase, sanitary wastes would be treated by a sewage treatment facility near the plant. Detailed designs for handling sanitary wastes would be submitted for review and approval by appropriate health authorities. Effluent from the treatment plant would be disposed in the tailings impoundment, and sludge would be disposed at an approved, off-site facility.

Most solid wastes would be transported off-site to an approved county landfill. No hazardous wastes would be generated by the operation. Inert wastes, such as wood and concrete, would occasionally be buried on-site in selected areas, in accordance with applicable state regulations and with KNF approval.

Transportation

Access to the proposed plant site would be via USFS Road 278 (Bear Creek Road) and Road 4781. Approximately 11 miles of the Bear Creek Road, from U.S. 2 to the Bear Creek bridge, would be paved and upgraded to applicable USFS standards. The road would be 20- to 29-feet wide, paved (chip-and-seal), and designed to handle speeds of 35 to 45 mph. Bridges on the road would be widened and upgraded to handle standard highway loads. Cuts and fills associated with new access roads and upgrading of the Bear Creek Road would total 22 acres. While Bear Creek Road is upgraded (one to

two years), USFS Road 231 (Libby Creek Road) would be used for access.

From the Bear Creek bridge to the Ramsey Creek plant site, 7.5 miles of road would be relocated and reconstructed. This section of road would also be a chip-and-seal surfaced road and 20- to 29-feet wide. Five miles of this road would follow the tailings lines from the plant site to the tailings impoundment site. Four thousand feet of new, single lane road would be constructed as access for portions of the tailings lines.

Noranda would build a bridge across Ramsey Creek to provide access from the plant site to the Ramsey Creek portal patio. A temporary crossing would be used prior to bridge construction.

Maintenance of the main access road would be Noranda's responsibility, unless additional use by the KNF or other interests would warrant a cost-share agreement. This responsibility would revert to the KNF following project completion. Traffic to the mine would use U.S. 2 and would include employee commuting and weekday delivery of supplies (Table 2-5).

Public access to the areas surrounding operations would be restricted until mining and reclamation activities are completed. Undisturbed areas not fenced would not be restricted. Access to Poorman Creek and Cable Creek drainages would be unrestricted. Access to upper Ramsey Creek would be restricted by a gate at the plant site boundary. Libby Creek Road would remain open; access to the Libby Creek adit and disturbed areas would be restricted by gates and fences. Livestock grazing would be excluded from areas the project may disturb until vegetation is reestablished.

Power Supply and Other Utilities

The plant site's electrical service would be 230 kV, 3 phase, 60 cycle, provided via a new, overhead transmission line. The proposed route, known as the Miller Creek route, is shown on Figure 2-13. Two substations would be required. One substation would be used to tap the Noxon-Libby 230-kV line and supply power to the mine site over a new 230-kV transmission line. At the Ramsey Creek plant site, a second substation would be constructed to distribute electricity through lower voltage lines to equipment in various locations at the plant site, the Libby Creek adit, and the tailings impoundment site, and within the underground mine.

Annual energy consumption is estimated at 280 million kilowatt hours, with a peak demand of 40,500 kilowatts. Telephone service would be supplied by a buried cable line along the Bear Creek access road. Construction and routing of the proposed transmission line is described further in the following sections.

Substation equipment and location. Noranda

Table 2-5. Estimated daily vehicle count.

Vehicle	Daily trips	Vehicle types	Time
Concentrate trucks	21	20-ton capacity	Day shift
Supply trucks	5	Various	Day shift
Pickups	30	0.5 to 1 ton capacity	10 per shift
Employee vehicles	300	Cars and 0.5 to 7.5 ton trucks	Day shift 134 Swing shift 83 Night shift 83

Source: Noranda Minerals Corp. 1989a. V.No 1, p. II-115.

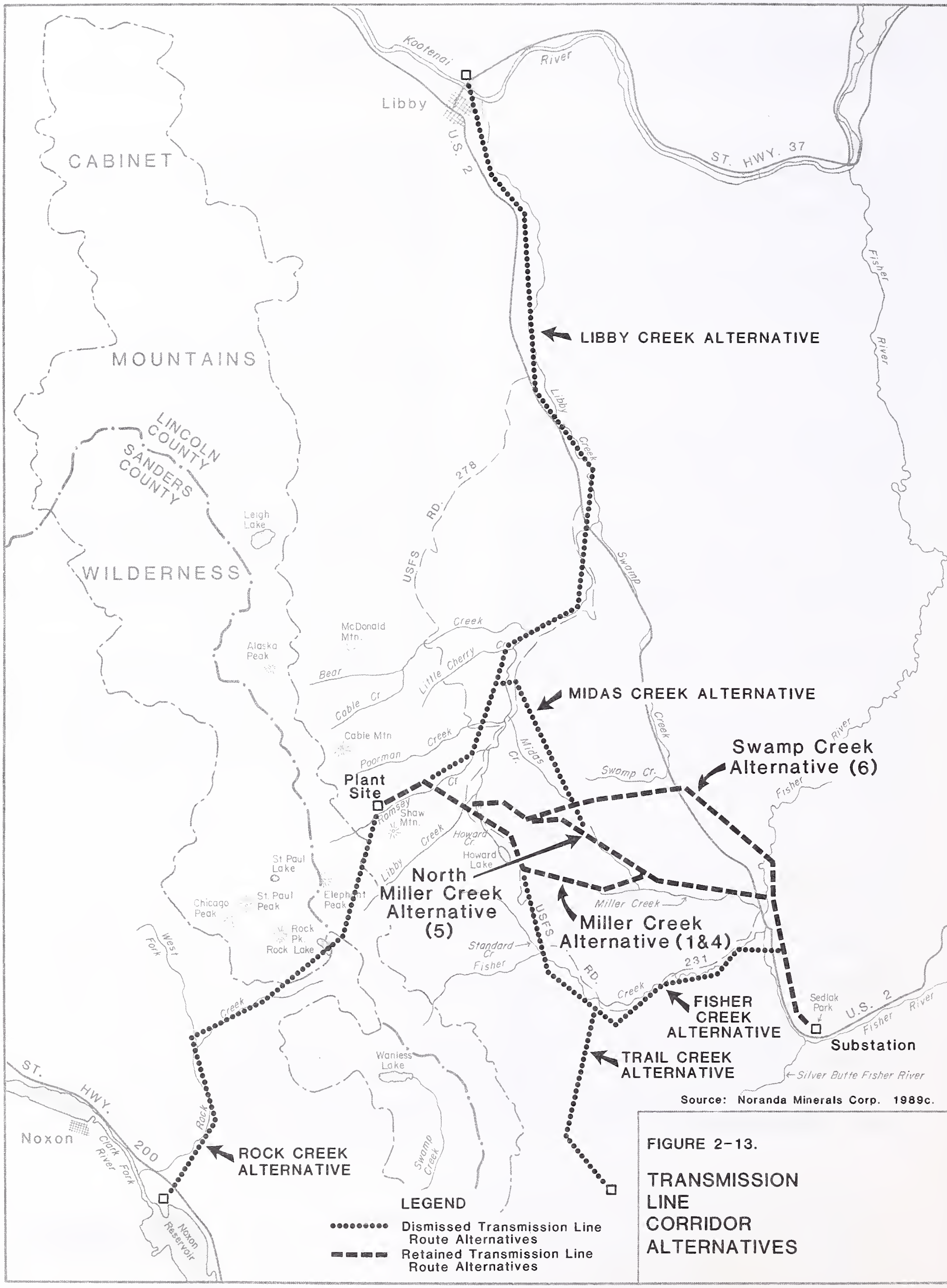


FIGURE 2-13.

TRANSMISSION LINE CORRIDOR ALTERNATIVES

would use monopole steel construction for the transmission line from a new substation on BPA's Noxon-Libby 230-kV line near Pleasant Valley, Montana (Figure 2-13). The proposed site is in an area known locally as Sedlak Park, about 30 miles southeast of Libby. The BPA would build and operate the new substation.

The substation would require a site about 250 by 300 feet and be located adjacent to the existing transmission line. Placement of the substation may require some cut-and-fill at the site and relocation of Sedlak Creek. The substation site would be fenced. No water would be required at the site, and toilet facilities would be self-contained.

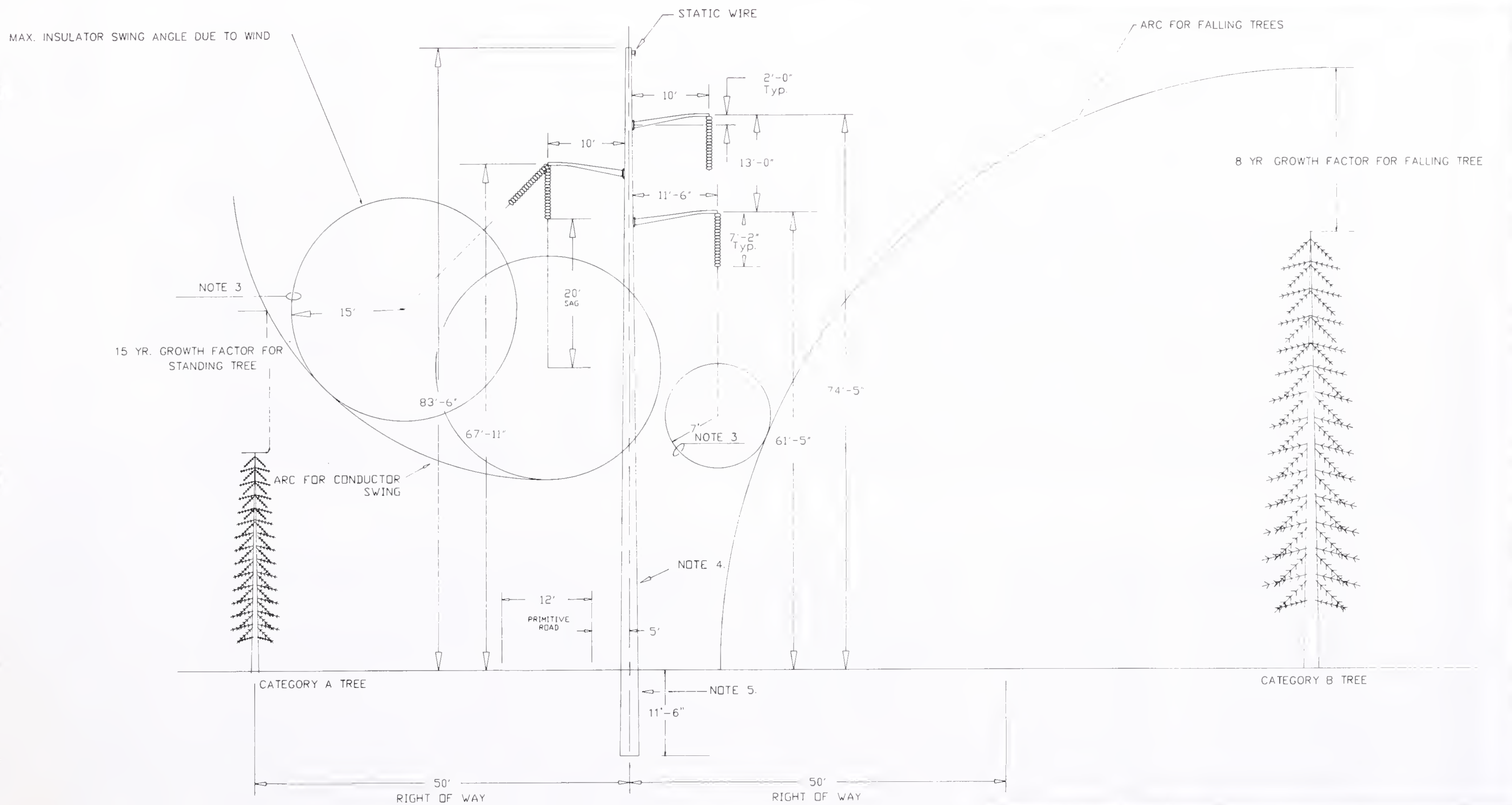
No piece of equipment would contain more than 50 gallons of insulating oil, and the total amount would be less than 1,320 gallons. The insulating oil would not contain PCBs. The size of the substation and amount of insulating oil used would not require an oil spill containment system, although substation design would minimize the potential for spills. Any spills would be cleaned up in accordance with applicable regulations.

Substation construction would also include installation of necessary communication and automatic safety equipment to disconnect power in the event of problems on the new line or the interconnected transmission system. Microwave telecommunications to the Sedlak Park substation site would be provided by construction of a passive microwave repeater station. The general location for this microwave repeater would be in the area of Barren Peak, four miles west of the substation site (see Figure 2-13). The actual location of the microwave repeater would require a line-of-sight view of the substation. Several locations near Barren Peak would offer such a view, but additional field work to finalize a location must be done by the BPA, the DNRC and the KNF. The 40-foot tall repeater station would occupy an area 100 feet by 100 feet and would be constructed using helicopters to minimize disturbance. A 150-foot tower would be required at the Sedlak Park substation.

Proposed transmission line route. Noranda's proposed transmission line route would follow the Fisher River and U.S. 2 north from the substation site for four miles. The route then would turn west and generally follow the Miller Creek drainage to its headwaters where it would cross into the Libby Creek drainage (Figure 2-13). About 0.25 miles south of Howard Lake, the line would turn northwest, passing east of Howard Lake, crossing Howard and Libby creeks at the Libby Creek Recreational Gold Panning Area. The route would continue northwestward from Libby Creek, crossing Ramsey Creek, and then would generally follow Ramsey Creek to the plant site. An additional substation would be constructed at the plant site (see Figure 2-9) to distribute electricity to equipment at the mine site, tailings impoundment, and the Libby Creek adit.

Line construction methods. Steel monopole structures would be used to reduce tree clearing and visual impacts along the 100-foot right-of-way (Figure 2-14). The steel poles would be built to provide low reflectivity and long life. The typical pole would rise 83.5 feet above ground and be embedded about 12 feet in the ground. The average span between poles would be 750 feet (about seven structures per mile). The low point in the conductor sag would be 40 feet above the ground. Three conductors with a horizontal spacing of about 20 feet and a vertical spacing of 6.5 feet are proposed. A 0.5-inch static wire for protection against lightning strikes would be located at the top of each pole 17 feet above the top conductor.

Line construction would require use of both light and heavy equipment operated by a 23-man crew. Figure 2-15 shows typical construction activities and wire-stringing operations. The line would be designed and operated to comply with applicable Rural Electrification Administration and National Electric Safety Code standards. Noranda would adopt



NOTE 1. ONLY THOSE TREES THAT FALL OUTSIDE ARC FOR FALLING TREES AND INSIDE ARC FOR CONDUCTOR SWING WILL BE REMOVED

NOTE 2. SEE DOCUMENT "GENERAL DESCRIPTION OF RIGHT OF WAY AND CLEARING REQUIREMENTS FOR PRIMARY (230kV) AND SECONDARY (13.2kV) LINES FOR EXPLANATION OF DIMENSIONS AND TERMS

NOTE 3. MOMENTARY EXPOSURE ZONE

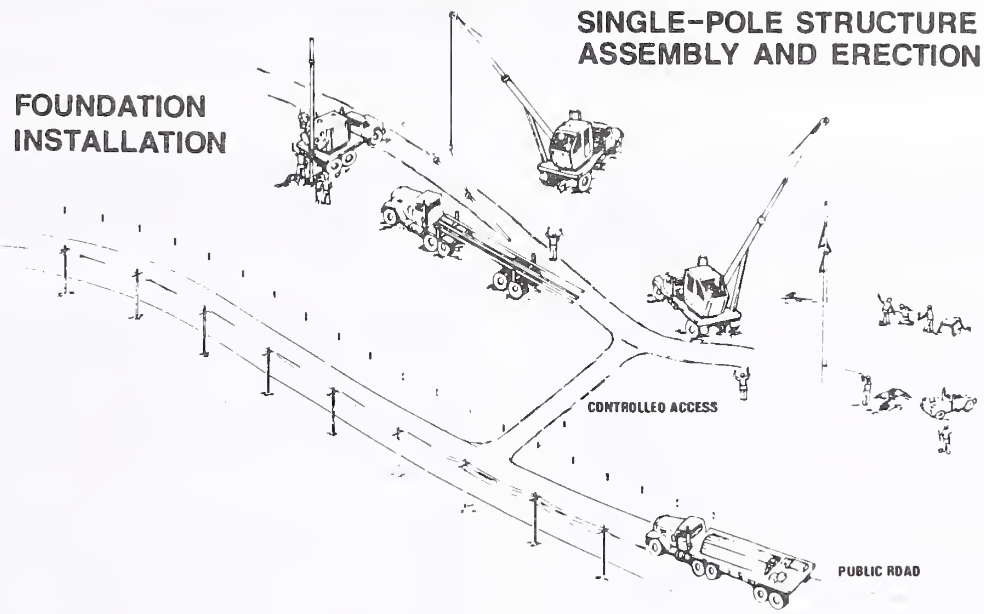
NOTE 4. BLACKENED GALVANIZED STEEL 95' MONOPOLE.

NOTE 5. COAL TAR EPOXY TREATMENT.

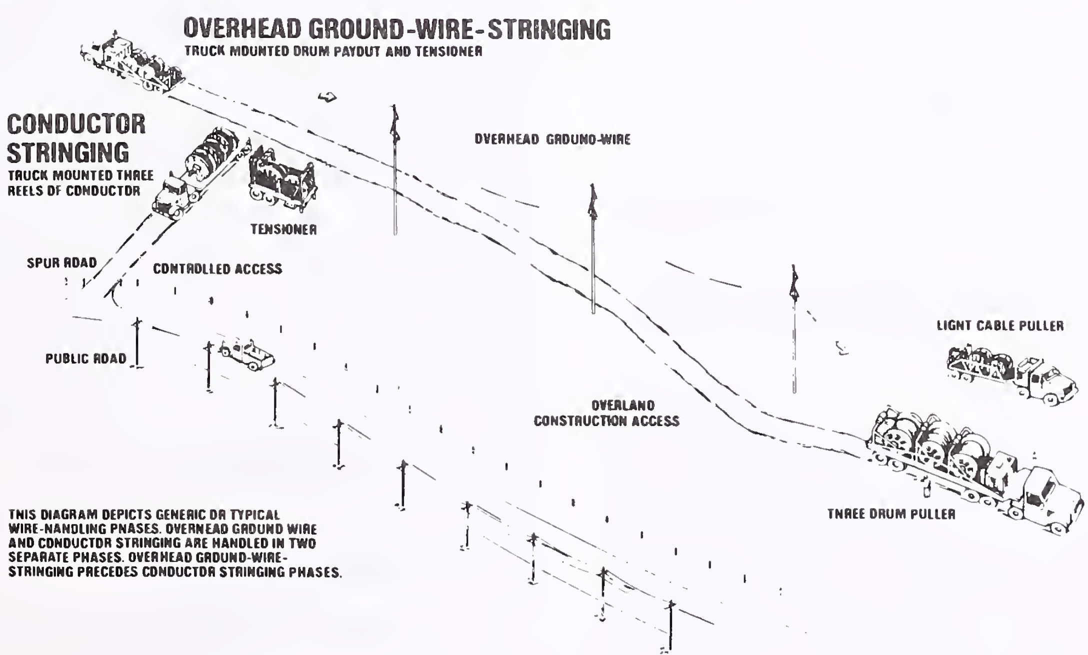
Figure 2-14.

Clearing Requirements for the Transmission Line.

Source: Noranda Minerals Corp. 1989c.



Typical Construction Activities



Basic Wire-Handling Equipment

Figure 2-15.

Typical Transmission Line Construction Activity.

Source: Western Area Power Administration. 1986.

DNRC's Environmental Specifications (Appendix F) to guide line construction, operation and maintenance activities.

Most construction activity would be contained in the right-of-way, with major exceptions being access roads and conductor pulling and stringing. General right-of-way clearing would be governed by safety, reliability, environmental and cost considerations. A 100-foot right-of-way would be cleared as necessary along the full length. Additional tree clearing outside the 100-foot right-of-way would be necessary to prevent trees from falling into the line, or fires from flashovers where trees are too close to the conductor. This would produce a "feathered" edge on the right-of-way clearing, with the actual width of right-of-way clearing varying along the line (Figure 2-14). Final centerline placement would determine tree removal requirements. Clearing for the conductor stringing operations by a crawler tractor would require clearing an eight- to ten-foot swath by removing all timber, brush, and slash with a bulldozer down the center of the right-of-way.

Road construction. Existing roads would be used for construction access where possible, and primitive roads or spurs would be built where necessary. New roads would be 12- to 14-feet wide and cleared of all trees and shrubs. Wood refuse and cleared shrubs would be placed on the downhill edge of theroad for erosion control. A primitive road within the right-of-way would be required for line stringing operations across side slopes greater than ten percent. On all access roads, suitable topsoil would be moved uphill of the road for replacement following construction. Drainage for new temporary roads and stream crossing requirements for construction activities would be evaluated jointly before construction by the agencies and Noranda. Stream crossings would be constructed to meet KNF and BNRC requirements.

Ground disturbance necessary for some pulling and tensioning sites may extend up to 100 feet beyond the right-of-way boundary where the line makes an angle. These sites usually require an area up to 50 feet by 150 feet. The proposed route would require about eight of these sites.

Pole placement. Pole placement activity is expected to occur within 30 feet of the holes where the poles would be installed. Activities conducted outside the 30-foot radius would include framing conductor supports and establishing an operating location for the crane. The optimal crane operating conditions require that the crane be as close to the hole as possible but, because of uneven terrain at certain sites, cribbing with timbers under the crane outriggers would be necessary to level the crane. The need for the crane to be outside of the 30-foot radius is expected to be the exception.

A small area next to the pole site would be covered by 1.5 cubic yards of backfill material brought in from offsite. This sand and gravel material would be placed within approximately ten feet of the pole hole and used for backfill.

Where bedrock is encountered while excavating pole holes, a rock drill and compressor would be used to drill the rock. A hole would be blasted using explosives. Blasting would not expand the area needed for operations around the hole, but would increase the amount and duration of associated construction activity. It also would slightly affect the sequence and schedule of operations around those holes, extending the amount of time that the poles remain at the site before they can be set.

Operation and maintenance. Upon completion of line construction, Noranda would—

- scarify and reseed soil disturbed within the right-of-way;
- spread material removed from pole holes not used as backfill around the pole location and reseed;
- replace soil removed from new access roads back to the roadbed;
- reseed new access roads and place berms across them to prevent use by unauthorized vehicles; and

- remove berms where necessary to allow road use by line repair equipment and replace berms following repair completion.

Noranda would select a utility to operate and maintain the line. Annual line inspection would be conducted by helicopter to assess structural integrity and to identify maintenance needs. The conductors, insulators, and poles would be examined periodically by inspectors on the ground.

Land use in the right-of-way normally would not be restricted except for those activities that interfere with the line operation and maintenance. Line operation would not require any permanent employees, although Noranda would have a trained fire crew and would cooperate with the KNF and local fire departments in controlling forest fires in the area.

The proposed line is expected to have a life equal to that of the proposed mine. The nature of the loads and mine power requirements would not require expansion of the transmission line. Following completion of mining, the transmission line would be removed using equipment similar to that used during construction. Reclamation at the end of the line's life would include removal of all facilities, and revegetating access roads, pole sites, and the right-of-way. Transmission line reclamation is further discussed under Reclamation.

Project Employment

The preproduction phase would entail—

- access road construction;
- mine development and mill construction;
- transmission line construction;
- plant access road alterations;
- tailings embankment and related facilities construction; and
- installation of service facilities.

It is estimated 30 employees would begin work the first quarter of Year 1 and employment would peak during Year 2 with 530 employees over a 30-month period. All surface construction and the majority of underground mine development during the preproduction phase would be completed by contractors. Noranda anticipates contractors would work a seven-day work week with three shifts a day.

Following completion of the construction period (at the end of the third year), total employment is estimated to be 450 workers, with an annual payroll of $12 million. This level of employment is expected to remain constant throughout the mine life.

Following completion of all surface construction, and mine and mill development, full production would be achieved over a 12-month period. Permanent project facilities would operate 24 hours a day, 7 days a week, for 350 days a year.

Economic Impact Mitigation Plan

Noranda is preparing a Hard Rock Mining Impact Plan which will describe how the Montanore Project would affect local government services, facilities, costs and revenues. The plan will specify the measures Noranda would undertake to mitigate adverse fiscal impacts to local government units. The plan will be made available to the public concurrent with the draft EIS. As discussed in Chapter 1 and Chapter 4, the DSL cannot issue a permit until after the Impact Plan has been accepted.

Reclamation

Noranda's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KNF Forest Plan. Specific objectives include—

- protecting air, surface water and ground water permanently;
- removing potential hazards to protect public health and safety;
- maintaining public access in most of the project area;
- restoring wildlife habitat;
- designing a land configuration compatible with the watershed;

- reestablishing an aesthetic environment, with consideration of visual quality and recreational opportunity; and
- reestablishing a vegetation community appropriate for the post-mining land use.

Noranda would accomplish these objectives by stabilizing disturbed areas during and following operations. Noranda has developed specific plans for each disturbed area, which are briefly described in the following sections.

Tailings impoundment. Components of the tailings impoundment would be reclaimed incrementally to minimize potential long-term erosion and maximize tailings dam stability. The reclamation plan would consist of the following—

- forming a berm with tailings along south and east sides of the impoundment;
- spreading an average of six inches of coarse tailings on the impoundment surface;
- lowering the water level in the impoundment, then grading the surface;
- replacing topsoil (18 inches or 24 inches) and preparing a seedbed; and
- revegetating all disturbances.

The tailings impoundment would be reclaimed to the configuration in Figure 2-16. The side slopes of the impoundment, having undergone concurrent reclamation during construction, would remain as built during the project's operational phase. The tailings berm formed along the south and east sides would be graded to the northwest at a 0.5 to 1 percent slope. Noranda anticipates that a shallow depression may form in the center of the impoundment due to tailings settlement. During grading activities, the depression would be filled with coarse tailings, mine waste rock, or material from the north saddle dam. Potential settlement of the pond surface would be estimated during final reclamation studies. Noranda anticipates reclamation of the tailings impoundment can be completed within one to two years.

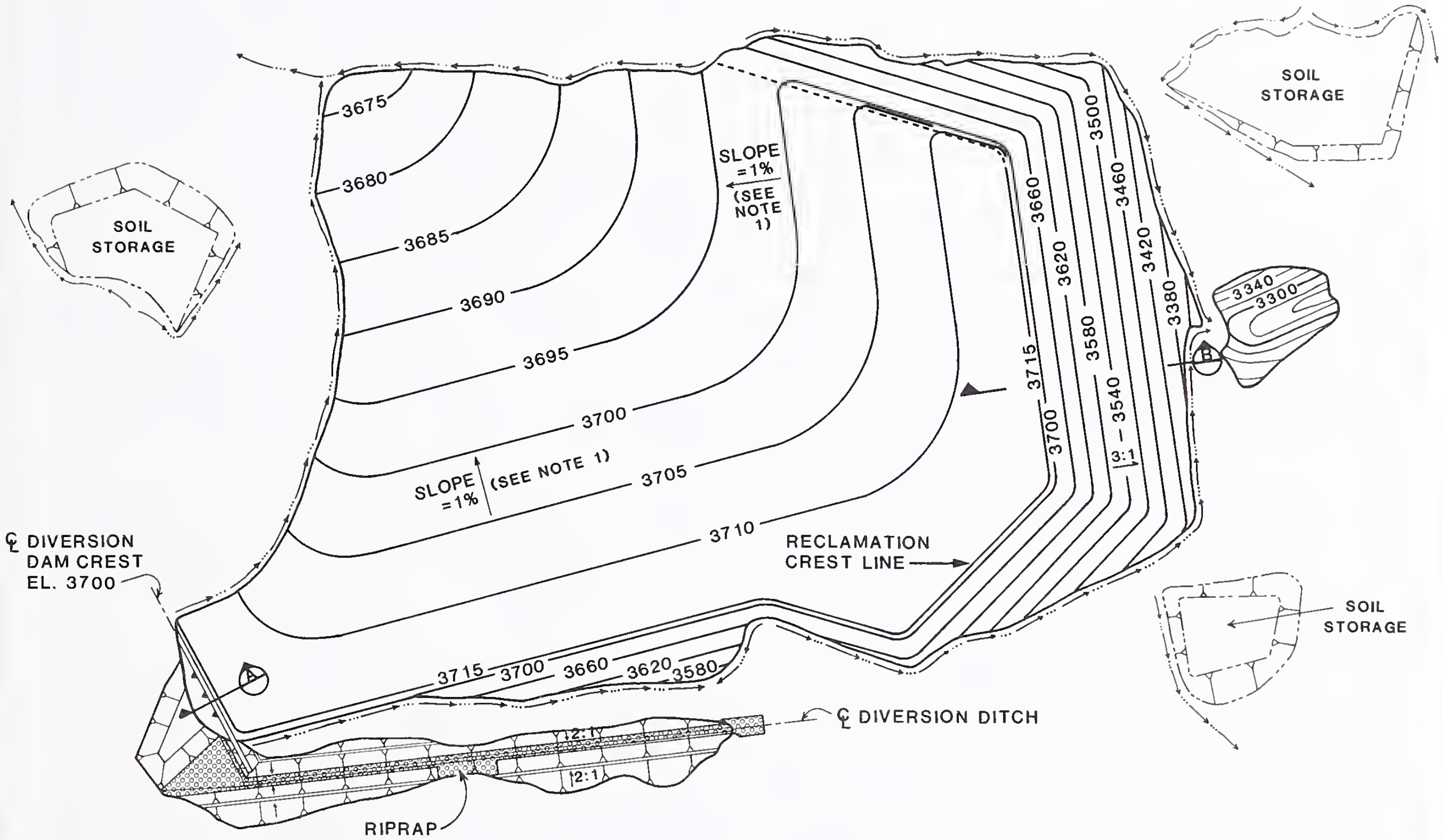
The north saddle embankment would be removed and the surface runoff from the impoundment would flow via a diversion ditch towards Bear Creek. A small check dam would be built just beyond the northwest end of the reclaimed impoundment. Sediment would be removed from behind the dam, if necessary.

The diversion structures above the reclaimed tailings impoundment, designed for the Probable Maximum Flood event, would remain, routing runoff into the permanent diversion channel. Seepage through the tailings embankment would continue following reclamation. The seepage collection dam would remain in place until water quality objectives are met. Seepage collected in the pond would be pumped to the tailings impoundment where it would evaporate or be used for irrigation. Following removal, the seepage collection dam would be graded to approximate original contour.

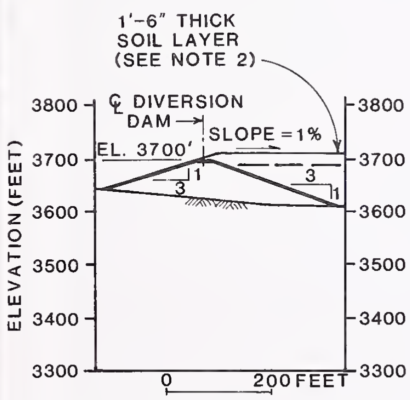
All mechanical facilities associated with the tailings impoundment, including the pipelines, would be removed. All areas associated with the impoundment would have soil materials replaced and revegetated following operations.

Noranda has recognized in the permit application that the tailings impoundment should be considered for designation by KNF as a "special management area". Noranda would cooperate with the agencies in developing appropriate post-mining management for the tailings impoundment area.

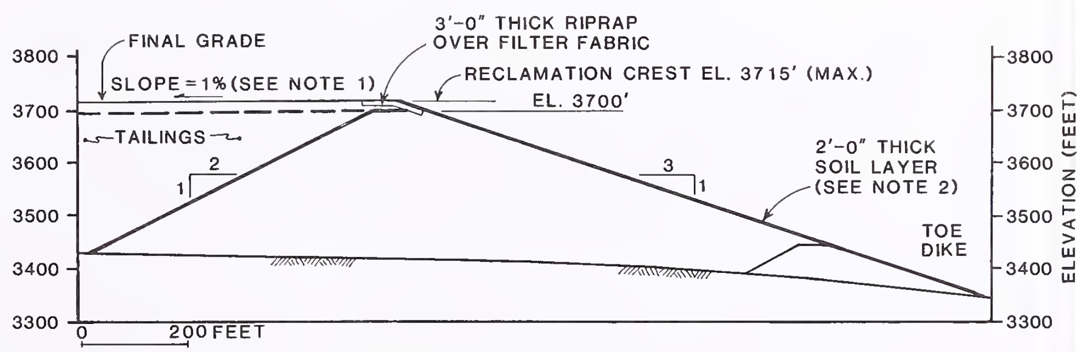
Plant site. All structures would be removed, and above- and below-grade features would be restored to a final topography shown in Figure 2-17. The patio would slope west to east at about five percent. The cut-and-fill slopes around the plant would be revegetated following construction. If the cut-and-fill slopes are not vegetatively stabilized by plant closure, they would be reduced to 50 percent by pulling fill into the cut and by grading the berm into the cut. Internal roads and parking areas would be graded to approximate original contours and revegetated.



POST-MINE TOPOGRAPHY



CROSS-SECTION A



CROSS-SECTION B

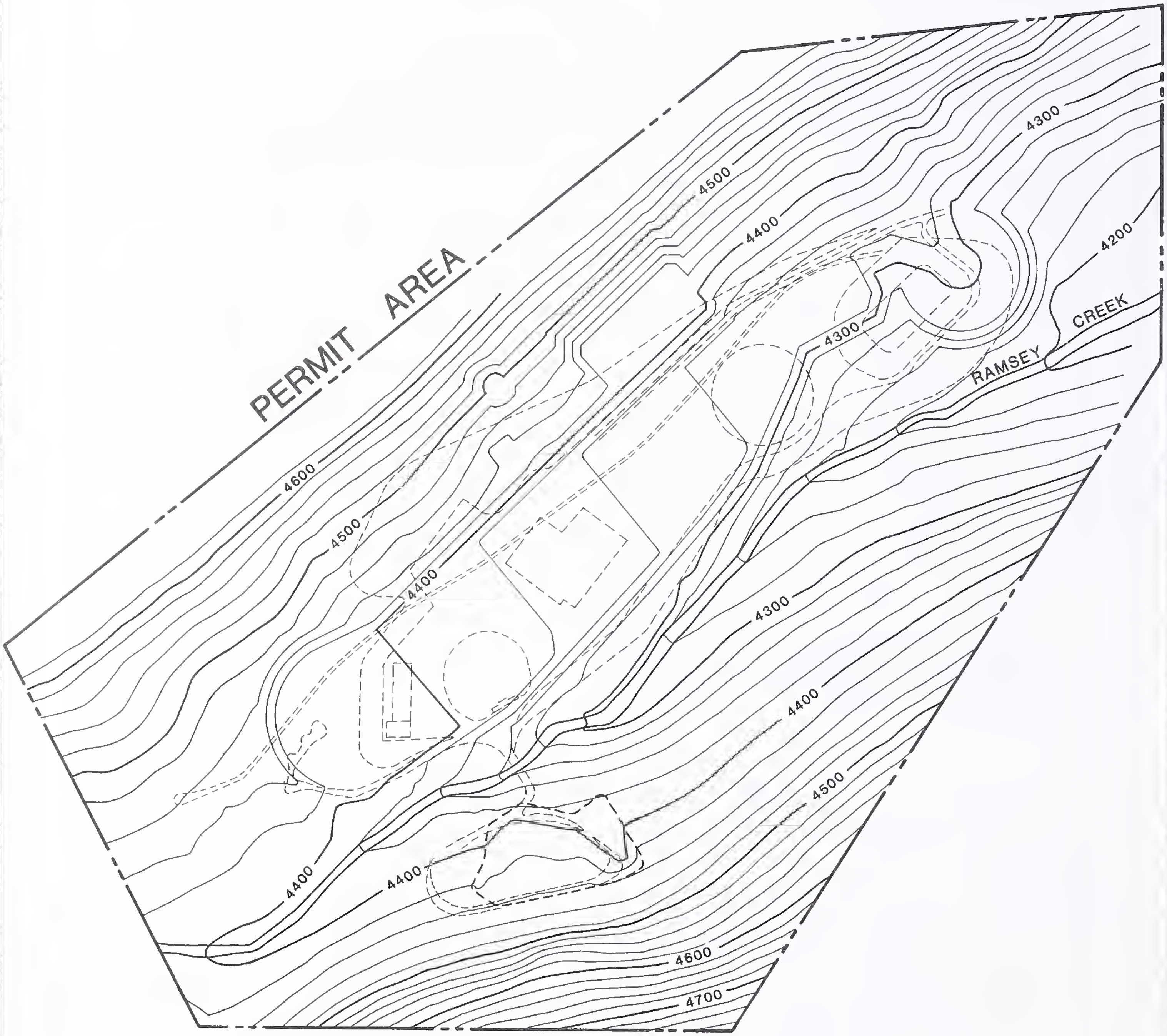
Source: Noranda Minerals Corp. 1989a.

NOTES:

1. SLOPE COULD VARY FROM 0.5% TO 1%. FINAL SLOPE TO BE DETERMINED DURING RECLAMATION DESIGN.
2. SURFACE TO BE SEEDED WITH GRASS

FIGURE 2-16.

POST-MINING TOPOGRAPHY — TAILINGS IMPOUNDMENT SITE



Source: Noranda Minerals Corp. 1989a.

Contour Interval Equals 20 Feet

FIGURE 2-17.

POST-MINING TOPOGRAPHY — RAMSEY CREEK PLANT SITE

Libby Creek adit site. Reclamation of the Libby Creek adit site would follow procedures described for the plant site. All structures would be removed, and above- and below-grade features would be restored to a final topography shown in Figure 2-18.

Adits. Adit portals would be permanently closed upon completion of operations. Closure techniques would depend on whether water is or would be produced at the opening. Dry openings would be sealed by backfilling waste rock from the portal patio.

Noranda would use water inflow data obtained during mining to predict the amount and quality of water expected from the adits. If, based on this information, it is determined water quality standards would be exceeded, concrete or other types of adit plugs would be considered.

Waste rock and percolation ponds. All waste rock is expected to be used in various construction activities. If construction requirements do not exceed waste rock production, or if more economical borrow material becomes available, one or more waste rock storage areas would remain. These areas would be graded to 50 percent slopes, topsoiled and revegetated. Other design characteristics of the waste rock areas, such a height or size, would be dependent of total volume remaining. Percolation ponds would be revegetated.

Transmission line. Following construction, land on the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. Access roads not needed for maintenance would be recontoured, scarified, and reseeded. All permanent cut-and-fill slopes on maintenance roads would be seeded, fertilized, and stabilized with hydromulch, netting, or other methods. Drive-through dips, open-top box culverts, waterbars, or crossdrains would be installed on maintenance roads to prevent erosion; unauthorized traffic would be blocked with appropriate structures.

At the project end, the line would be abandoned. Structures, conductors, insulators, and hardware would be removed from the right-of-way. All disturbed areas would be recontoured and revegetated. Where culverts are removed, streambanks would be recontoured and reseeded. Shrubs, such as alder or willow, would be planted on streambanks to reduce bank erosion during high streamflow.

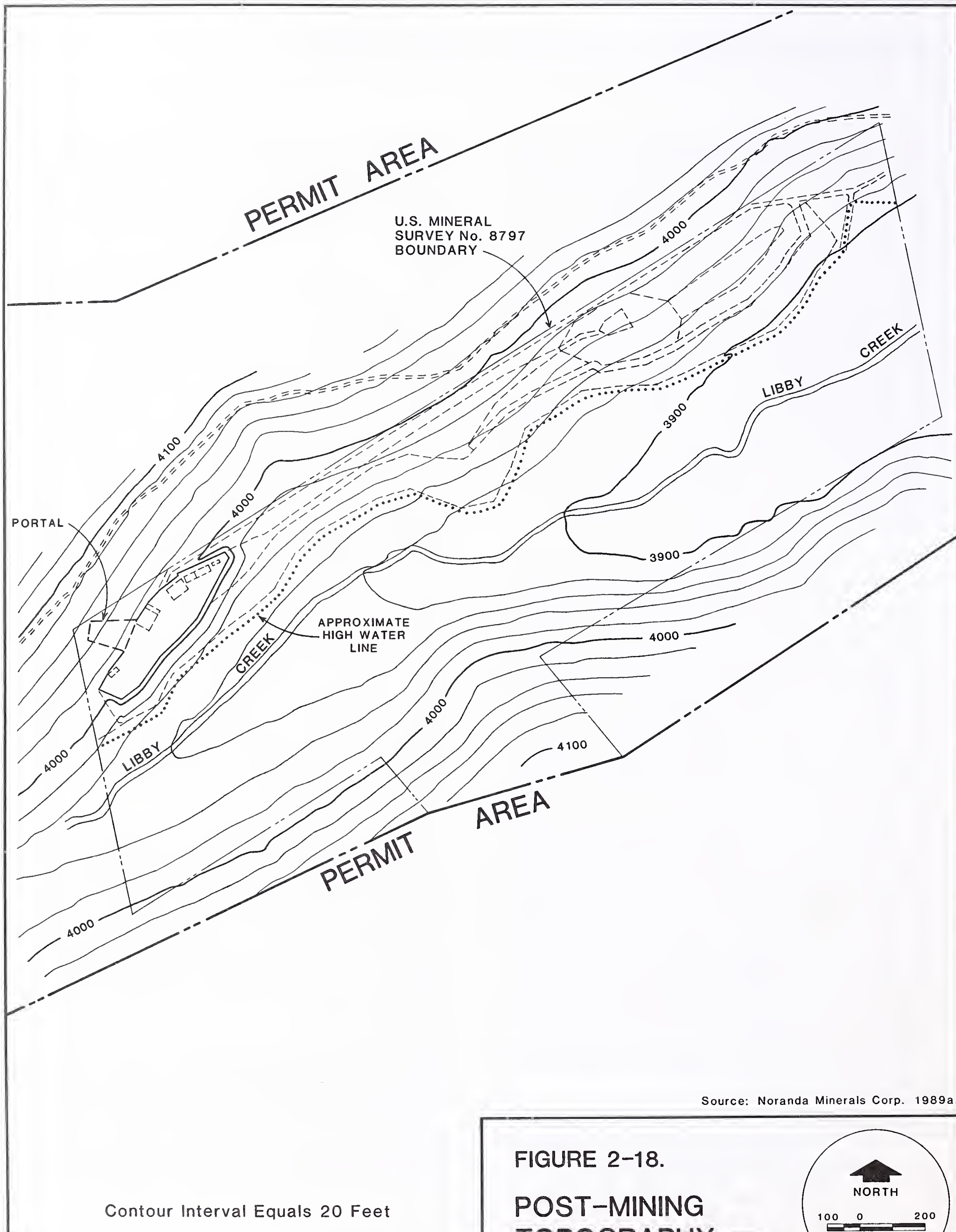
Roads. The Bear Creek access road, from U.S. 2 to the Bear Creek bridge, would remain 20- to 29-feet wide. Soil would be salvaged from disturbed areas and redistributed on cut-and-fill slopes where possible. The main access road from the Bear Creek bridge to the plant site would be returned to a 15-foot width, unless the KNF should want a wider road.

The road following the tailings slurry pipeline would be stabilized with revegetation mixture after construction; it would be removed following operations, topsoiled and revegetated. The temporary crossing from the plant site to the Ramsey Creek portal patio would be removed following bridge construction. Any disturbance along Ramsey Creek to the Libby Creek adit road would be reclaimed following construction activities.

Soil salvage and handling plan. Noranda would salvage and replace soils on most disturbed areas. Merchantable trees would be purchased and harvested on all areas to be disturbed prior to soil salvage. Noranda would schedule timber removal in cooperation with the KNF.

The suitability of soils proposed for salvage was determined from physical and chemical data collected during the baseline soil survey (Western Resources Development Corp., 1989b). Soils containing more than 50 percent rock fragments are generally unsuitable for salvage. Some soils with rock fragments up to 60 percent, however, would be salvaged to provide erosion protection on the impoundment dam.

Some soils would be salvaged in two lifts (or layers), while only the surface layers of others would be salvaged (Table 2-6). Not all soils suitable for reclamation would be salvaged. Suitable layers of some soils, such as the Andic Cryochrepts or the Andic Dystrochrepts, would not be salvaged because



Source: Noranda Minerals Corp. 1989a.

FIGURE 2-18.

POST-MINING TOPOGRAPHY — LIBBY CREEK ADIT SITE

Table 2-6. Soil suitability and proposed salvage depths.

Soil	Suitable depth	Proposed salvage depth Lift 1	Lift 2
	(in.)		
Andic Cryochrepts	29	18	0
Andic Cryochrepts	20	18	0
Andic Dystrochrepts	65	10	12
Andic Dystrochrepts	9	9	0
Andic Dystrochrepts, moderately deep	11	11	0
Andic Dystrochrepts, deep	9	9	0
Andic Dystrochrepts	9	9	0
Typic Humaquepts	15	15	0
Typic Cryochrepts/ Cryumbrepts	0	0	0
Typic Cryorthents	0	0	0
Typic Glossoboralfs	33	8	25
Cumulic Humaquepts	9	9	0
Typic Paleboralfs	24	9	15

Source: Noranda Minerals Corp. 1989a. V. 1, pp. I-81*ff* and V. 2, pp. III-36*ff*.

other suitable soils would be available to meet the proposed replaced soil quantities (Table 2-7). Steep slopes or a high water table would preclude the salvaging of some soils. Total soil salvage acreage does not equal total disturbance acreage (Table 2-1) because soil would not be salvaged from stockpile sites, powerline corridors, or areas where soil has already been removed (such as existing roads).

Soil stockpiles would be constructed with 40 percent side slopes and 33 percent sloping ramps where possible. As stockpiles reached their design capacity, they would be stabilized and seeded during the first appropriate season following stockpiling. Fertilizer and mulch would be applied as necessary to promote successful revegetation.

Soil would be salvaged and replaced without stockpiling when feasible, primarily at the tailings impoundment, or stockpiled as close as possible to redistribution sites. Compaction and handling would be minimized as much as possible. Topsoil replacement depths would average about 24 inches on the impoundment dam and 18 inches on all other disturbed areas. Soil would not be redistributed on access road slopes with exposed bedrock.

Prior to redistribution, compacted areas (especially the adit portal areas, roads, soil stockpile sites, and facilities area) would be ripped to reduce compaction. Ripping would eliminate potential slippage at layer contacts and promote root penetration. Soil salvage and redistribution would occur throughout the life of the operation.

Revegetation. Seed mixtures and rate selection were based on the expected moisture, temperature, and soil conditions, as well as types of species available for revegetation found in existing vegetation communities. Two mixtures have been developed—one dominated by species typically found in moist, relatively cool sites, and one with hardier species (Appendix A).

Table 2-7. Soil salvage acreages and volumes.

Facility	Acreage	Volume (yd^3)
Tailings impoundment	595.3	1,895,200
Seepage collection pond	13.3	44,900
Diversion ditch	44.8	57,100
Plant site	44.9	104,900
Libby Creek adit site	18.7	41,700
Waste rock storage area and percolation pond no. 1	58.0	207,400
Percolation pond no. 2	20.0	88,700
Total	795.0	2,439,900

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-37*ff*.

Seeding rates were designed to average about 90 to 100 live seeds per square foot for drill seeding and roughly twice that for the broadcast rate. Drill seeding would occur on slopes of 33 percent or less. Rocky slopes, areas where organic debris has been spread, or slopes greater than 33 percent would be broadcast or hydroseeded. Seed mixtures may be modified due to limited species availability, poor seed quality, site differences, poor initial performance, or advances in reclamation technology. Forbs would be removed from seed mixtures used on roadsides to avoid attracting bears.

Fertilizer application rates would be based on soil tests; phosphorus fertilizer would be applied prior to seeding, and nitrogen fertilizer would be applied in growing seasons subsequent to seeding. On slopes of 33 percent or less, the seedbed would be disced and harrowed. After seeding, straw mulch would be applied and anchored at 0.5 to 1.5 tons per acre, depending on the seeding method. Some hydroseeded areas would be mulched with a cellulose fiber mulch and a tackifier (a material used to adhere the mulch to the ground surface).

Tree and shrub seedlings would be planted in selected areas of the plant site, the Libby Creek adit area, and the tailings impoundment area. Shrubs and trees would not be planted on soil stockpile sites and portal patios, along road corridors, or in the powerline corridor, relying instead on natural revegetation. Stocking rates would be 435 trees per acre and 200 stems per acre for shrubs. Seedlings would be planted either continuously in strips on steeper slopes or in highly visible areas, or in randomly placed groupings on level to gently sloping areas. Containerized seedlings would be used when available; stocking rates would be increased when bare-root stock is used.

Interim revegetation would take place on certain disturbed areas (i.e., roads, stockpiles, powerline, pipelines, and other areas) to reduce erosion and sedimentation. These areas would be broadcast seeded with the interim seed mixture, mulched and fertilized as necessary (Appendix A). As the tailings dam is increased in height, it would be periodically reclaimed using the permanent seed mixture. All other unreclaimed disturbances would be reclaimed within two years after mining and processing completion.

Erosion Control

Wind and water erosion control measures are detailed throughout Noranda's permit application. These measures are summarized in Table 2-8. Proposed air emission control techniques are described in Noranda's air permit application (TRC Environmental Consultants, Inc., 1989). These measures involve—

- mechanical practices to minimize fugitive dust;
- grading and soil handling techniques to enhance stability;
- hydrologic systems to control runoff and sedimentation; and
- revegetation practices to provide a stabilizing cover.

Tailings may blow during summer and fall when the impoundment surface or the tailings dam face is sufficiently dry to allow wind erosion. Sprinkler irrigation and/or revegetation would be used to reduce windblown tailings and provide interim stabilization. Soil replacement and revegetation would provide long-term tailings stabilization.

Interim Monitoring Plans

Noranda has developed an interim monitoring program to provide a continuation of data gathering for surface and groundwater resources in the project area. The objective of the program is to provide for the seasonal collection of water resource information to extend the database beyond the one-year baseline investigation. The program encompasses the period of time between the completion of the baseline studies and the construction/development phase of the project. Noranda has submitted its first summary

Table 2-8. Erosion control practices proposed by Noranda.

Hydrologic practices	Soil erosion control practices	Revegetation practices
Constructing drainage and diversion systems, including energy dissipators and sediment traps at all disturbance sites to control runoff and sedimentation	Salvaging of soils concurrently with disturbances to the extent possible	Including rapidly developing and sod-forming plant species in seed mixtures
Diverting naturally occurring runoff around the plant site and Libby Creek adit site	Direct haul soil handling (soil salvage and immediate redistribution) whenever feasible	Revegetating in the first appropriate season after soil redistribution
Collecting all water originating within the plant site and routing to a drainage sump for later use	Periodic watering and sprinkling of all unpaved roads with dust suppression agents	Applying mulch (or tackifiers on hydromulched areas)
Intercepting soils eroding from dam faces	Using a sprinkler system, if necessary, to control blowing tailings	Protecting revegetated areas disturbed by banning traffic until vegetation is established
Stabilizing and revegetating rills and gullies	Spraying coarse ore storage area with water to control emissions	Stabilizing disturbed areas with interim revegetation
Installing benches at 15 to 25 feet intervals on cut-and-fills sideslopes at the plant site	Covering all transfer points at concentrate loadout	Planting trees on the tailings impoundment face and surface
Constructing erosion bars on unpaved roads	Inspecting slopes throughout the operation to monitor slope stability	Planting shrubs on road cut-and-fill slopes if necessary
Placing riprap on the dam crest and uppermost part of the tailings impoundment dam face	Implementing interim and long-term revegetation of soil stockpiles to minimize wind and water erosion	Broad-cast seeding of slopes exceeding 33 percent
Lining the Little Cherry Creek diversion channel with three feet of riprap and placing rock-filled bars to dissipate flow energy	Using Best Management Practices to control sediment (see Soil and Water Conservation Handbook, Kootenai National Forest, 1987, Appendix 25)	
Placing windrows of woody debris parallel to slope contours at the bases of long fills		
Minimizing right-of-way clearing to reduce the total area susceptible to erosion		

Source: Noranda Minerals Corp. 1989a and 1989c.

report on the interim monitoring program to the agencies (Chen-Northern, Inc., 1990).

The surface water monitoring program includes water sampling, field measurement, and flow measurement of surface waters in the Libby Creek drainage. The following surface water monitoring stations are included in the program—

- Libby Creek: LB 200, LB 300, LB 800, LB 2000;
- Little Cherry Creek: LC 100, LC 600;
- Ramsey Creek: RA 200, RA 600; and
- Poorman Creek: PM 500, PM 1000.

Sampling and flow measurement for these stations occurs on a seasonal basis (quarterly). Surface water samples are analyzed for the same parameters analyzed in the baseline study (Chen-Northern, Inc., 1989). In addition, the quality control program and general sampling protocol of the baseline study are used. Samples would be collected and analyzed monthly for total suspended solids (TSS).

Lake levels in Rock Lake, Saint Paul Lake and the southern-most Libby Lake are also monitored. The proposed monitoring program focuses on identifying lake water levels during high and low water level periods. Water levels are measured from an established level on the lake shore and a photographic record would be obtained.

Ground water resources monitoring involves the measurement of static water levels during early summer (high water table) and late fall (low water table) periods. Static water levels are measured in the existing monitoring well network which was established for the baseline investigation and in any geotechnical boreholes which remain accessible. Monitoring wells included in the interim monitoring program are—PLCM-6 (shallow), PLCM-6 (deep), LCTM-8, LCM-9, LCM-10, LCM-11, RCDH-1, DH-15, and WDS-1. Ground water samples are collected from these wells and analyzed for the same parameters and detection limits which were used during the baseline investigation (Chen-Northern, Inc., 1989).

Operational and Post-Operational Monitoring Plans

Noranda has also proposed monitoring programs which would be implemented during operations. Monitoring programs for revegetation, tailings dam stability, hydrology and aquatic life are included in Noranda's permit application. These programs, as proposed, are summarized in the following sections. The agencies have reviewed these proposed programs and have developed additional monitoring requirements. The monitoring program which would be implemented if the project is approved is presented in Appendix B—Monitoring.

Hydrology. Surface and ground water would be monitored during operations. Samples would be collected and analyzed; proposed analyses are shown in Appendix B. Surface water would be monitored for quality and flow in the Ramsey Creek, Little Cherry Creek and Libby Creek drainages. The following surface water monitoring stations are included in the program—

- Libby Creek: LB 200, LB 300, LB 1000, LB 2000;
- Little Cherry Creek: LC 100, LC 800; and
- Ramsey Creek: RA 100, RA 200, RA 600.

Ground water monitoring wells have been installed for baseline monitoring in the project area and particularly in the proposed tailings impoundment area. Monitoring wells planned for the Montanore Project would include the following—

- Up-gradient and down-gradient of the plant site on Ramsey Creek and downgradient of proposed water disposal areas adjacent to Ramsey Creek;
- A series of monitoring wells peripheral to the tailings pond including downgradient of the seepage collection pond; and
- Downgradient of the Libby adit portal and water disposal area.

Noranda would develop a post-mining hydrologic monitoring program in coordination with the agencies prior to mine closure. Noranda would

submit the plan to the agencies for review and approval prior to end of operations. The monitoring program would include surface and ground water sampling, primarily downgradient of disturbed areas. Wells in the tailings impoundment and plant site areas would be monitored; stations on Ramsey, Libby and Little Cherry creeks would be sampled. Hydrologic monitoring would include periodic ground water level and streamflow measurements. Any adit discharge would be monitored for quality and flow. Water levels in tailings impoundment would be periodically measured.

Aquatics. Noranda would monitor aquatic macroinvertebrate populations at five sampling locations in the project area. These stations would include one each in Ramsey, Poorman, and Bear creeks, and two in Libby Creek. Each station would be sampled at three intervals—during the spring, summer and fall. Sampling data would be tabulated and presented to the agencies in an annual report.

Tailings dam stability. Tailings dam stability would be monitored during the operating period and after the mill operation ceases. Monitoring would consist of visual inspection, water level measurements, seepage quantity measurements, and elevations surveys.

Revegetation. The vegetation cover, species composition, and tree planting success would be evaluated during the first year following reseeding or replanting. In addition to a general evaluation, Noranda would conduct a detailed reclamation evaluation at sites representative of various types of disturbance. The following would be evaluated—

- plant species responses;
- success of steep, rocky slope reclamation;
- soil redistribution depth;
- soil rock fragment content;
- effects of fertilizer rates;
- tree planting techniques and stocking rates; and
- differences between bare-root and containerized planting stock.

Soils would be tested for macronutrient content and appropriate fertilizers formulated. Prior to soil redistribution, tailings and waste rock would be sampled for revegetation constraints; analytical parameters would include texture, rock fragment content, pH, and acid-base accounting. Depending on pH values, selected trace elements would be analyzed. Rills or gullies on reclaimed areas would be stabilized and reseeded. Surface water control structures would be maintained until areas are stabilized to prevent excessive erosion.

For two years, revegetated areas would be protected by fencing where necessary from vehicle and livestock use. Wildlife damage control would include selective fencing, chemical repellents, or terminal bud protection coverings. Noxious weeds would be mechanically controlled or selectively sprayed during the life of the operation to reduce invasion of reclaimed areas. A noxious weed control plan would be developed in accordance with the Lincoln County Weed Board and, where applicable, with KNF guidelines.

Grizzly Bear Mitigation Plan

The Montanore Project would affect existing grizzly bear habitat. These effects are described in detail in Chapter 4—Wildlife. Noranda has prepared a mitigation plan to address these impacts. The plan consists of three components—

- habitat replacement/habitat enhancement;
- mortality control; and
- plan management.

Habitat replacement/habitat enhancement. Noranda would replace affected habitat, protect existing habitat, or increase effectiveness of existing habitat to compensate for habitat affected by the Montanore Project. Noranda would cooperate with a proposed Management Committee (see Plan Management section) in selecting the measures necessary to

compensate for the habitat loss. Habitat replacement would be accomplished through a combination of—

- road closures;
- fee title transfer to the KNF;
- purchase of private lands by Noranda and establishment of conservation easements during the project life; and/or
- acquisitions of conservation easements on other private lands during the project life.

Noranda would transfer title of private land in the tailings impoundment area and the Libby Creek adit area to either the KNF or a private trust at the end of operations. These areas would provide 390 acres of habitat. In addition, Noranda would compensate for habitat disturbance through either protection or enhancement of existing habitat. Noranda would be responsible for purchasing all land and conservation easement acquisitions and for managing lands other than those transferred to the KNF. Prior to acquisition of any land to mitigate or compensate for habitat losses, Noranda would conduct studies of each prospective parcel to determine the parcel's habitat value. All prospective parcels for acquisition would be in currently occupied grizzly habitat in the Cabinet-Yaak Ecosystem.

Noranda also proposes that KNF would close on a year-round basis 10.9 miles of existing National Forest System roads and close an additional 20.1 miles of National Forest System roads on a seasonal basis from April 1 through June 30 each year (Figure 2-19). Year-round closures would occur on the Upper Bear Creek Road (#4784), the Cable-Poorman Road (#6214), the Ramsey-Libby Road (#6210), and the Upper West Fisher Road (#6746). Seasonal closures would occur on the Upper Miller Creek Road (#4724) at the junction of the 385 Road, the South Fork of Miller Creek Road (#4726), the Midas Creek Road (#4778), and the lower Granite Road (#4791) at its junction with Road #4792.

Habitat replacement would occur over an 11-year period. Noranda has proposed the following schedule for compensation—

- 25 percent of affected habitat would be replaced within 2 years from start of construction; and
- 25 percent of affected habitat would be replaced in each of Years 3, 6, and 9 of operations.

Mortality control. Noranda would fund the salary of one full-time enforcement officer through the Montana Department of Fish, Wildlife and Parks (or equivalent funding agreed to by the Management Committee) throughout the project life. Additionally, Noranda would fund the salary of one full-time local information and education person through the first five years of the project. After the first five years, equivalent funding would be provided by Noranda for the same position or other activities approved by the Management Committee. Noranda would also support evaluation of effects of selective hunting season restrictions in areas of high grizzly bear use on the grizzly bear population.

Plan management. Noranda would work closely with a Management Committee responsible for administering the compensation program. Noranda has proposed the committee consist of supervisory personnel from the U.S. Fish and Wildlife Service, the Montana Department of Fish, Wildlife and Parks, the KNF, and Noranda. The committee would approve all specific habitat acquisition, enhancement, replacement or protection proposed by Noranda prior to implementation. Noranda would prepare yearly progress reports on the plan's implementation. Noranda would provide a letter of credit, trust fund, bond or similar financial instrument to guarantee periodic payments as necessary to ensure plan implementation.

ALTERNATIVE 2—NORANDA'S MINE PROPOSAL WITH MODIFICATIONS

Modifications proposed by the agencies to Noranda's mine proposal include mitigating measures designed to reduce or eliminate identified environmental impacts not adequately mitigated by Noranda. The amount of operational and post-operational monitoring would be increased. These modifications

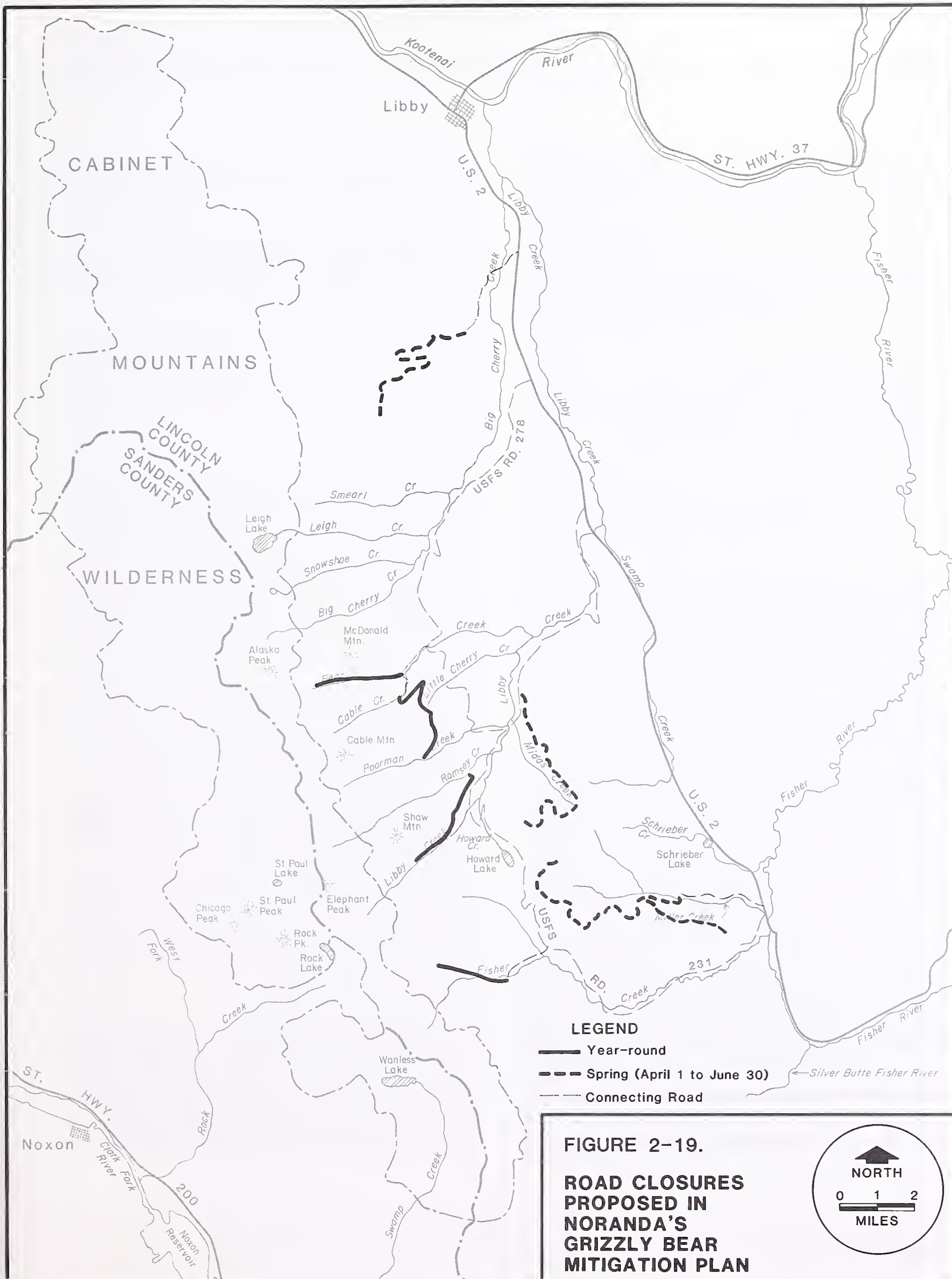


FIGURE 2-19.

ROAD CLOSURES PROPOSED IN NORANDA'S GRIZZLY BEAR MITIGATION PLAN

have been developed in response to the significant issues identified by the public and the agencies during the scoping process. The following sections describe the identified significant issues and the proposed modifications. All other aspects of Noranda's mine proposal would remain as described in Alternative 1. This alternative could be selected with any of the transmission line alternatives.

Proposed Mitigation—Issue 1

Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear.

The agencies have selected several measures as appropriate for compensation and mitigation. These measures are designed not only to protect the current grizzly bear population in the Cabinet Mountains, but to help meet the goal of recovery established in the KNF Forest Plan (Kootenai National Forest, 1987). The mitigation measures are designed to reduce the effects of the proposed Montanore Project. The selected measures include modifications to Noranda's operating plan and funding by Noranda of several compensation and mitigation measures. Implementation of some of the measures would be the responsibility of the U.S. Forest Service (USFS).

Habitat acquisition. Noranda would fund the acquisition of habitat over a four-year period to replace the estimated 1,174 grizzly bear habitat units affected as a result of Montanore Project activities (see Chapter 4 for impact analysis). It is estimated that 4,696 acres of suitable private land would be acquired. The acreage estimate is based on the following assumptions. An average acre in the three Bear Management Units (BMUs) adjacent to the project area (see Chapter 4) represent .34 habitat units. Bear Management Units are areas of land managed for grizzly bear recovery. This figure was derived simply by dividing the total number of habitat units in the three BMUs (approximately 70,000) by the total acreage of the three units (approximately 205,000). The average value of habitat units to acres is 3.0. For purposes of determining habitat acquisition requirements, a factor of 4.0 was used to convert habitat units to acres. This factor may be high, since it is very uncertain as to the quality of habitat that could be purchased. Some habitat may be acquired that is currently below average values. It is also conceivable that only below average habitat would be available for purchase.

At the USFS' discretion and following reclamation, Noranda transfer in fee title to the USFS any mill site claims patended in conjunction with the Montanore Project. This would prevent future development of patented lands.

Information and education program. Noranda has proposed funding the salary of one full-time local information and education person through the first five years of the project. After the first five years, equivalent funding would be provided by Noranda for the same position or other activities approved by the Management Committee. Under the agencies' modifications, Noranda would fund the position for the mine life. The agencies would develop a program which would be implemented by the information and education person. The program would include periodic presentations on grizzly bear conservation to school age children in all communities where mine workers live; semi-annual presentations on grizzly bear conservation to all mine employees; presentations of grizzly bear conservation information to all new employees as part of a new employee orientation program; and cooperation with agencies involved with grizzly bear conservation by providing posters, pamphlets, or other informational material regarding grizzly bear conservation to groups, clubs, recreational users, or individuals who could use bear habitat or could have potential conflicts with grizzly bears.

Law enforcement. Noranda would provide funding for increased law enforcement activities by the responsible agencies. Efforts would be directed towards ensuring public compliance with regulations, such as road closures and other measures. Increased enforcement is designed to aid

in the conservation and recovery of the grizzly bear. The program would be funded for the life of the project.

Prior to permit issuance, Noranda would provide a lump sum payment to a Trust Fund administered by the KNF, Montana Department of Fish, Wildlife and Parks, and the U.S. Fish and Wildlife Service. The fund would be used to cover all projected costs of land acquisition, wildlife professionals' salaries, and other administrative costs.

Other measures. Other mitigation proposed by the agencies for the grizzly bear and other wildlife include the following—

Noranda and its contractors would expressly prohibit the possession of firearms by all employees within all permit areas and in company vehicles. Strict enforcement of this measure would minimize opportunity for poaching and decrease hunting pressure.

The KNF would establish a speed limit not to exceed 45 mph for all access road traffic to reduce road kills.

The KNF would close Big Hoodoo Mtn. Road (#6747) to all motorized traffic during the winter season (December 1 to April 30). This measure would reduce the impact from the expected displacement of moose in the tailings impoundment area.

An education program for construction and mine workers would be instituted to increase awareness of wildlife concerns. Such training would include explanation of company policy toward the enforcement of wildlife management and protection regulations, policy toward firearms, and related issues. This program would be in conjunction with Noranda's proposed grizzly bear education program.

Containers used for trash and garbage at all project facilities would be of a type that would not allow foraging by bears. Noranda would remove all road killed animals from roads and road rights-of-way within the permit area and along all access roads on a daily basis. Road kills would be moved at least 100 feet beyond the right-of-way clearing and be out of sight from the road. These measures would reduce interaction between humans and grizzly bears.

Proposed Mitigation—Issue 2

Issue—Changes in the type, quality and displacement of general forest recreational activity and on the area's aesthetic qualities.

Noranda would implement a mandatory busing program to transport workers to project facilities. Parking areas for employees at the pickup locations would be located in accordance with the KNF Forest Plan and would be situated to avoid creating a safety hazard. Noranda would develop a transportation plan during the construction phase with the goal of reducing vehicular traffic. This measure would significantly reduce traffic levels on the proposed access roads.

Noranda would restrict ore concentrate trucks from the access road during shift change periods when a large number of employees would be traveling the access road. This measure would reduce traffic congestion and increase road safety.

Noranda would return the Bear Creek Road from the Bear Creek bridge to U.S. 2 to its pre-mine width unless the KNF wanted a wider road. This measure would reduce post-mining road maintenance costs. The wider road would not be needed for the expected post-mining traffic levels.

Noranda would reconstruct portions of the Great Northern Mountain trail which originates near Howard Lake. This would partially mitigate the loss of the Ramsey Creek Road, which has been used as a trail since 1981.

If the Bear Creek and Libby Creek roads are snowplowed in the winter, Noranda would also snowplow turnouts. This would provide increased safety, access and recreational opportunity.

Noranda would construct an overflow parking facility on the Leigh Lake Road 3/4 mile downstream of the existing trailhead. This would minimize parking congestion and increase recreational opportunity.

Noranda would construct two additional day use sites at Howard Lake Campground. This would minimize day use crowding impacts as a result of potential increased use associated with mine development.

At the Libby Creek Recreation Gold Panning Area, Noranda would install three additional fire pits; construct 1/2 mile of new walking access in several locations; and install a precast concrete vault toilet. These measures would reduce the impacts of the anticipated increased use of the area.

Waste rock stockpiles and percolation ponds would be designed to minimize impacts to visual resources.

Noranda would develop three additional viewpoints, consistent with the Forest Plan, along the Bear Creek and Libby Creek roads focusing on the Cabinet Mountains. Noranda would undertake a roadside tree management program with the goal of obscuring views of the tailings impoundment from Libby Creek Road. These measures would mitigate the effects of the tailings impoundment on key viewpoints on the Bear Creek and Libby Creek roads.

Noranda would institute the air quality monitoring program described in Appendix B. The monitoring information would be used to verify compliance with the applicable ambient air quality standards. It would also be used in conjunction with visual observation of the operation by the agencies to evaluate the effectiveness of the proposed emission control measures and determine the need for any additional control measures as described in Chapter 4.

Proposed Mitigation—Issue 3

Issue—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation.

Earth-tone paints would be used at project facilities. This measure would reduce the visual contrast of the facilities as viewed from the Cabinet Mountains Wilderness with the surrounding vegetation.

Noranda would ensure all equipment has properly maintained mufflers and other noise control equipment. Noise levels associated with equipment would be less than the EPA standard. This measure would ensure acceptable noise levels at the project facilities and along the access road.

Where possible, backup beepers would be replaced with the strobe light-type warning devices and the sound level of the backup beepers would be reduced to less than the normal 110 dB(A) at 10 feet. Regulations stipulate that the sound level of backup beepers must be audible in affected work areas. Sound levels of 90 to 100 dB(A) at 10 feet would provide audible warning at distances up to 50 feet behind a large front end loader.

Noranda would install a sound attenuator on all permanent ventilation fans. Noranda would also design and submit for agency review and approval an earthen berm on the west side of the Ramsey Creek portal. These measures would reduce the noise in the Cabinet Mountains Wilderness associated with the adits.

Proposed Mitigation—Issue 4

Issue—Socioeconomic changes, including employment, income, community services, population, and public finance.

Noranda would develop written policies concerning local hiring and develop a worker training program. These policies and training program would seek to maximize local hiring, with the goal of obtaining at least 80 percent local hiring rate for operations workers, and 50 percent local hiring rate for construction workers. This would ensure a minimal number of new people moving to the area.

Proposed Mitigation—Issue 5

Issue—Concerns about the location and stability of the tailings impoundment.

The KNF would amend the Forest Plan (Kootenai National Forest, 1987) for the proposed tailings

impoundment area. The new management area, affecting the area surrounding the tailings impoundment (729 acres), would be MA 31–Mineral Development. Management Areas are discussed in more detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of MA 31 are described in Appendix E.

Noranda would institute the tailings dam and impoundment monitoring program described in Appendix B. This program is design to ensure the stability of the tailings dam throughout the life of the project.

Proposed Mitigation—Issue 6

Issue—Changes in quantity and quality of water resources.

As part of final design, Noranda would submit for agency review and approval detailed plans on measures necessary to ensure compliance with surface water quality standards during all phases of the project. Plans would include a detailed description of the proposed pressure relief well system and of the system necessary to meet standards during all phases of the project.

A comprehensive program would be developed to minimize the amount of water flowing into the underground workings; to avoid affecting overlying surface waters; to minimize the potential for acid mine drainage and other adverse effects on water quality; and to monitor surface and ground waters in order to define and correct any problems both during and subsequent to mining operations. Noranda would be required to develop this program in coordination with the agencies. Specifically, the program would consist of the following—

- Noranda would be restricted from mining within 200 feet of the Rock Lake Fault and 750 feet of Rock Lake. This would decrease the potential for intercepting significant quantities of water from the fault zone and affecting the water levels in the lake. Noranda would be permitted to mine closer to these areas if agency review of underground studies indicates that narrower avoidance areas would be acceptable.
- Noranda would monitor water flows into the mine, water levels at Rock, Libby and St. Paul lakes, and surface water discharge at Rock Lake. Continuous monitoring and evaluation of mine inflows would be required for three reasons—to determine any possible connection to surface waters; to assist in predicting whether discharge would occur at the mine adits following operations; and to determine the expected post-mining quality of the mine waters. Water level monitoring at the lakes and continuous monitoring of surface water discharges at Rock Lake would be used in conjunction with underground monitoring to determine if mining is affecting the lakes.
- Underground rock mechanics testing would be required to ensure the structural integrity of the mine workings. The mine would be designed to minimize the potential for post-mining roof collapse and fracturing into the surrounding rocks. This will minimize the amount of water flowing into the workings and the potential for sulfides in the collapsed rock affecting water quality. Specifically, Noranda would conduct uniaxial compressive testing on ore material to ascertain theoretical strength limits of pillars; conduct tensile tests, primarily on the roof rocks, to determine ultimate opening widths prior to roof failure; and conduct shear tests of roof, floor, and ore rock.
- Noranda would conduct chemical analyses on waste rock encountered by the mine adits and in the barren (lead) zone between the ore zones. If the material exhibits acid-generating potential, these materials would be separated from other waste rock for special handling. A detailed handling plan would then be developed and submitted to the agencies for approval. Drill samples would be collected from rocks overlying the mine and chemically analyzed to determine if they would be potentially acid generating. This information would be used along with other data to estimate post-mining water quality.
- Micro-seismic monitoring of fracturing in overlying rocks in the mined area to determine the extent of destress fracturing and to verify the barrier pillar thickness required to prevent interception of ground water.

- Other modifications to the proposed hydrologic monitoring program described in Appendix B.

Noranda would modify the proposed aquatics monitoring program as described in Appendix B. This program is designed to monitor metal concentrations in aquatic organisms, primarily fish.

Noranda would design a permanent diversion channel to transport runoff from the tailings impoundment surface to Bear Creek. The channel would reduce erosion along the hillslope and consequent transport of excess sediment into Bear Creek.

Noranda would construct the rockfill bars associated with the Little Cherry Creek diversion during construction of the diversion channel. These bars would be located within the diversion channel, upstream of the connection to the existing natural channel. These bars would reduce sediment transport to Little Cherry Creek and increase channel stability.

Noranda would implement runoff and sediment controls concurrent with construction. This would avoid undue sediment transport during the construction period.

Noranda would maintain runoff and sediment control systems on a monthly basis or after each significant precipitation event. As problems are identified, Noranda would adjust the runoff and sediment control systems to address identified problems.

Noranda would construct access roads in accordance with the Soil and Water Conservation Handbook requirements (Kootenai National Forest, 1987, Appendix 25). These guidelines would ensure adequate fish passage.

Noranda would begin immediate construction of a permanent bridge across Ramsey Creek to provide access to the adits. A temporary crossing, such as a culvert would only be used until the bridge is completed. Long-term use of a temporary crossing would not be in compliance with KNF standards and would increase erosion.

Noranda would develop a wetland mitigation plan for agency review and approval. The plan would mitigate impacts to wetlands caused by construction of Montanore Project facilities.

ALTERNATIVE 3—NORANDA'S MINE PROPOSAL WITH MODIFICATIONS AND WITH WATER TREATMENT

Based on the agencies' analysis, surface and ground water quality would be affected by Noranda's proposed discharges to the percolation ponds, and by seepage from the tailings impoundment (see Surface Water Hydrology and Ground Water Hydrology sections of Chapter 4). Pursuant to the non-degradation rules of the Montana Department of Health and Environmental Sciences (ARM 16.20.701 and ARM 16.20.1001), Noranda has submitted a petition to change the quality of ambient waters. Noranda's proposal would increase concentrations of some constituents, and, based on assumptions regarding quantity and quality of discharge, may preclude the present or reasonably anticipated uses, such as drinking water or protection of aquatic life.

The agencies developed three water treatment alternatives—wetlands, evaporation, and electrocoagulation—which would reduce or avoid potential changes in water quality. An alternative seepage collection system—gravel drains—has also been developed by the agencies. Other treatment methods and other seepage collection systems are available. The agencies' intention in developing these alternatives is not to dictate design to Noranda, but rather to inform the Board of Health and Environmental Sciences and the public that reasonable alternatives are available to reduce effects on water quality. Noranda would be responsible for developing final design of the gravel drain and water treatment system. The design would be submitted to agencies for review and approval.

This alternative incorporates Noranda's mine proposal with all modifications described under Alternative 2. The passive or active water treatment

alternatives could be selected with any of the transmission line alternatives.

Gravel Drains

A pressure relief/seepage collection well system has been proposed by Noranda. The system includes up to 110 wells near the toe of the impoundment dam. Because of the perceived uncertainties of the proposed well system, the agencies developed an alternative system to minimize the quantity of seepage exiting the impoundment.

Noranda would develop a system of high capacity granular underdrains beneath the starter dam, the tailings embankment and the tailings impoundment. Similar systems have been employed extensively in tailings dams for both stability and seepage control reasons (Stine et al., 1986; Dorey and Byrne, 1982; Caldwell et al., 1983). Large drains have been extensively employed in the mining industry beneath high waste rock dumps (Brawner, 1986). Drains are multipurpose elements and function both to promote dam stability and minimize seepage for environmental purposes. Long experience with flow through rockfill dams demonstrates the capacity of coarse rock to transmit large volumes of water (Leps, 1973). Filter criteria for design of drains have been applied for about 50 years as a matter of standard engineering practice (Cedergren, 1977).

The proposed extensive underdrain system to reduce hydrostatic heads (pressure from the water stored within the tailings impoundment) would consist of high capacity granular drains in the main drainages interconnected with granular crossdrains or corrugated perforated high-density polyethylene (HDPE) pipe wrapped in a filter fabric. This drain system could be connected to the currently proposed blanket drain system beneath the dam, ultimately leading to the seepage collection pond. Synthetic lining of the bottoms of the main underdrains where higher static heads exist could also be included and would minimize seepage from the drains.

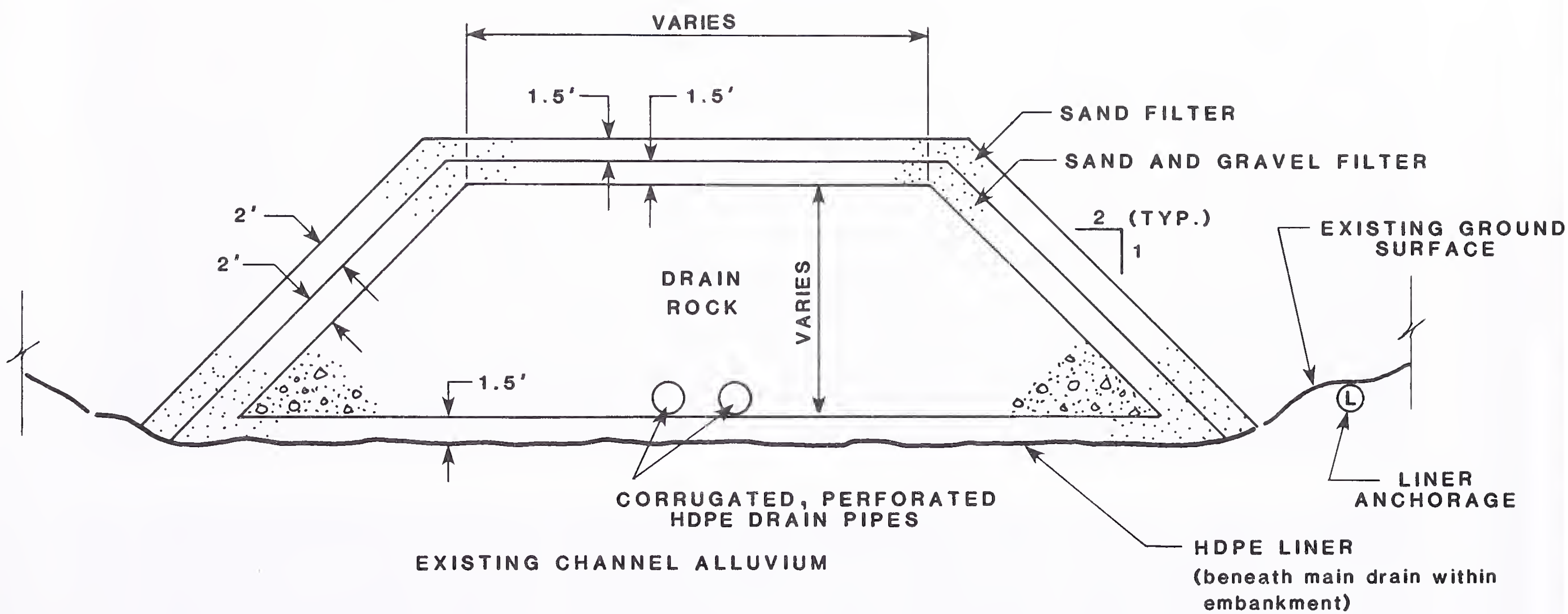
Because of the sloped impoundment surfaces, and with the presence of granular crossdrains or small diameter HDPE drain pipe, the tailings water would flow to the main drains and would be rapidly removed by these high capacity drainage elements, thereby maintaining low hydraulic heads. The synthetic lining, if included, would minimize seepage exiting the main drain, within which small hydraulic heads would be continuously present.

A typical suggested cross section of a drain beneath the starter dam and within the impoundment is illustrated in Figure 2-20. The main drain segment beneath the dam could be lined with a synthetic liner, such as high density polyethylene.

Drain rock and sand and gravel filter material could be produced by crushing harder rock from mine waste. The exact gradation of these materials and geometry of the drains could be established by an experimental crushing program, permeability testing and standard filter analysis (Cedergren, 1977) during design. Screening and blending operations may be necessary to produce the filter material.

To avoid plugging of the drain rock with tailings, the drain rock would be entirely encapsulated in filter material (Figure 2-20). The filter material would consist of a two stage filter of sand, and sand and gravel. This material could be obtained from surficial site soils or produced from processed mine waste rock. Filtration could also be achieved through the use of a filter fabric protected with coarse tailings sands in lieu of sand and gravel. The materials utilized should be relatively clean and their grain size distribution should be compatible with both the underlying drain rock and the overlying tailings.

Construction of the drains would progress ahead (upstream) of the impounded tailings as the impoundment fills. Tailings would be placed selectively to cover the drains to minimize inflow as the decant pond advances upstream over the drains. The purpose of this tailings cover would be to prevent excessive flow from the decant pond to the downstream collection pond, permitting maintenance



NOTE: Dimensions are for illustrative purposes only.
The actual dimensions would be developed during final design.

FIGURE 2-20.

TYPICAL DRAIN SYSTEM CROSS SECTION

of a decant pond. Placement of such a tailings cover over drains is routinely performed as part of the operation of many tailings disposal facilities, and is not a major operational difficulty.

Placement of the tailings sand cover above the drain rock would also increase the surface area and the effectiveness of the granular drains. As finer tailings slimes settle and consolidate over the drains, the effectiveness of the drains is reduced as the low permeability slimes reduce the flow entering the drains. Plugging of the drain rock by tailings could also occur in the event of damage to the overlying filters (sand and gravel or cycloned tailings sand and filter fabric). Such drains, however, are typically very conservatively designed, with flow capacities at least ten times the anticipated working flow rate, to guard against the potential for plugging. A good level of quality control would be required during construction of such drains to assure that filter and drain materials are of sufficient quality and are properly placed; the very conservative nature of the drain design also helps guard against detrimental effects of potential variation in materials quality and construction procedures.

As a second element of the drainage system, 3 or 4-inch diameter, corrugated and perforated, HDPE pipe wrapped with filter fabric or granular crossdrains could be placed throughout the impoundment. To prevent disruption of the pipes as tailings are placed, the pipes would be placed sequentially just above the tailings surface along topographic contours. The ends of the drain pipe would be terminated in the drain filter zones with caps being placed on the ends. In the event of collapse and intrusion of tailings into the pipes, this would prevent the tailings from entering and clogging the drain rock.

The underdrain system covered by a layer of slimes of relatively low permeability also would reduce heads beneath the decant pond. The reduction and the small size of the pond would serve to minimize the amount of seepage.

The drains within the tailings impoundment would be extended ahead of the tailings as they are deposited behind the starter dam and the progressively raised embankment. Estimated costs for construction of the drain system, ranging between $1 and $2 million, would be highly dependent on the availability of drain rock and filter materials, and the degree of processing necessary for production of these materials.

Seepage collected from the impoundment and excess mine and adit discharge water would be sent to a water treatment system. The amount of seepage collected by the drain system would be dependent upon the actual design of the drains. The agencies have estimated that 300 gpm of tailings seepage (out of 475 gpm in Year 16 of operations) would be collected by the system. The agencies have also estimated 85 gpm in Year 16 of operations would be collected by Noranda's pressure relief system and the remaining 90 gpm would enter the ground water system underlying the impoundment and ultimately discharge to Libby Creek. For a two-year period (Years 2 and 3 of construction), Noranda would pump mine and adit water to a water treatment system.

Three systems—one passive (wetlands) and two mechanical (evaporator and electrocoagulator)—are described in the following sections. The evaporator would have the highest overall removal rates. Wetlands and electrocoagulator systems are similar, and vary in removal efficiencies for particular water quality parameters (Table 2-9).

Wetlands

System description. Noranda would construct an artificial wetland system using emergent plants (aquatic plants growing above the surface) to treat excess mine water and seepage from the tailings pond. A wetlands treatment site would be built below the proposed seepage collection pond near the tailings impoundment and would discharge to Libby Creek. The exact size of the wetland would be determined in final design, but has been estimated by the agencies to be about 30 acres.

The use of aquatic wastewater treatment systems has grown substantially over the past 20 years. The systems are frequently used for treatment of acid mine drainage. Such systems generally have low installation and maintenance costs. They have been shown to remove a wide spectrum of water quality parameters with generally high removal efficiencies. Wetlands can be operated in cold as well as warm climates.

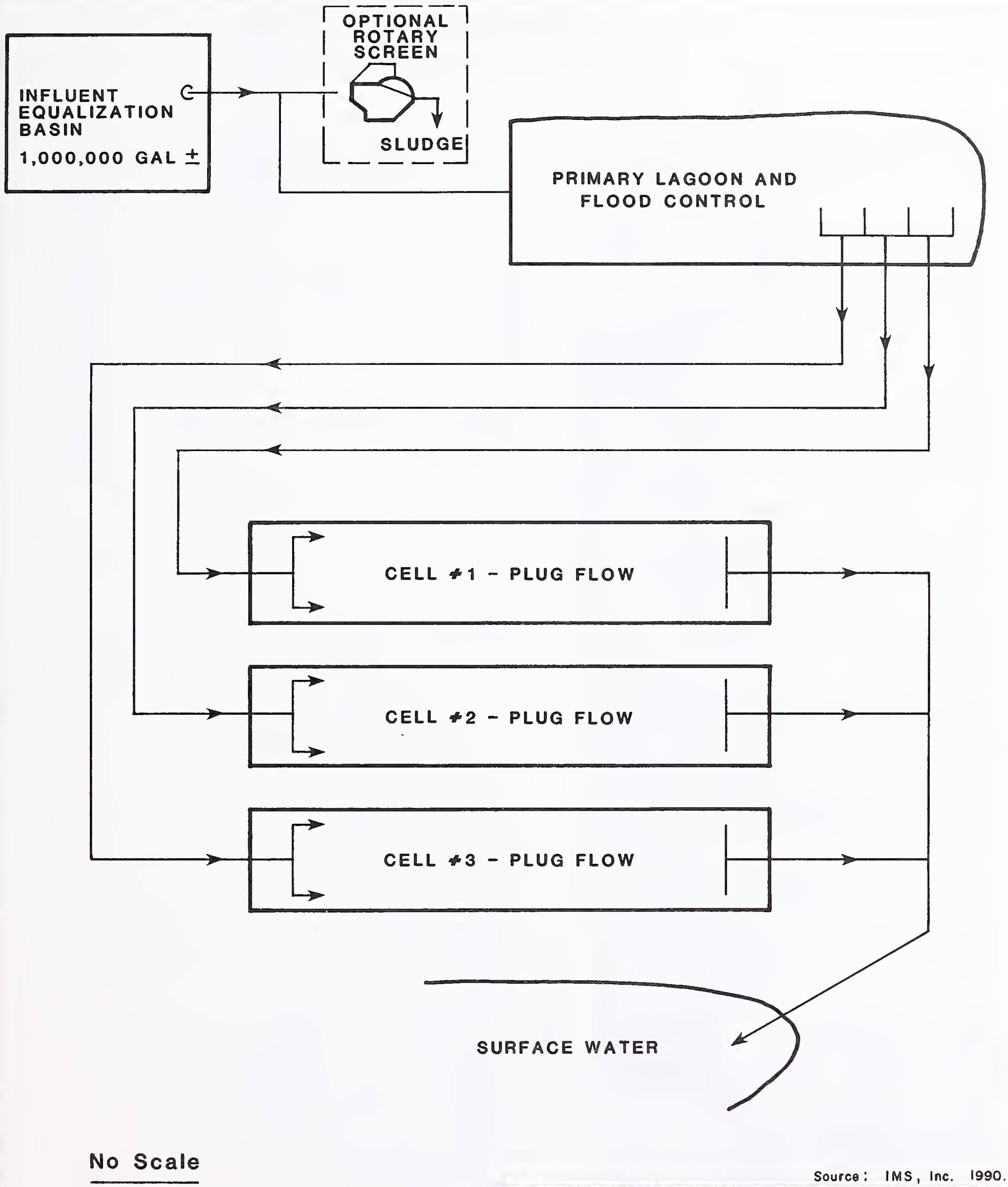
The wetlands would consist of an engineered system of trenches or beds underlain with an impermeable layer of clay or synthetic liner (Figure 2-21). The bed would contain growth media which would support aquatic vegetation. Commonly used media includes rock, sand, peat or mushroom compost. The media would be about 24 inches deep. Six inches of pea gravel would be placed above the media to facilitate planting of the emergent vegetation (Figure 2-22). Native plants, such as cattails and bulrush, could be used and would be suitable for the climate at the project location.

The system would be built with a slight slope (1 to 3 percent) between inlet and outlet. The typical length to width ratio for constructed wetlands of this type is less than 3:1. The inlet channel would be a perforated or gated pipe set into a transverse channel filled with large gravel. From there, the discharged water would flow horizontally through the rhizosphere (root zone of aquatic plants). The discharged water would be treated by filtration, sorption and precipitation processes in the soil and by microbiological degradation. The effluent would

Table 2-9. Estimated removal efficiencies for three water treatment alternatives.

Parameter	Wetlands (% efficiency)	source	Evaporator (% efficiency)	source	Electrocoagulator (% efficiency)	source
Total dissolved solids	No direct affect		95	(2)	95	(8)
Ammonia	79	(5)	95	(2)	No direct affect	
Nitrate/nitrite	73	(4)	95	(2)	74	(3)
Aluminum	43	(6)	95	(2)	75	(3)
Arsenic	Not known		95	(2)	37	(3)
Cadmium	99	(4)	95	(2)	98	(3)
Chromium	70	(7)	95	(2)	98	(3)
Copper	99	(4)	95	(2)	97	(3)
Iron	70	(6)	95	(2)	95	(3)
Lead	71	(1)	95	(2)	76	(3)
Manganese	66	(5)	95	(2)	71	(3)
Mercury	70	(7)	95	(2)	50	(8)
Molybdenum	Not known		95	(2)	50	(8)
Silver	95	(5)	95	(2)	97	(3)
Zinc	97	(4)	95	(2)	96	(3)

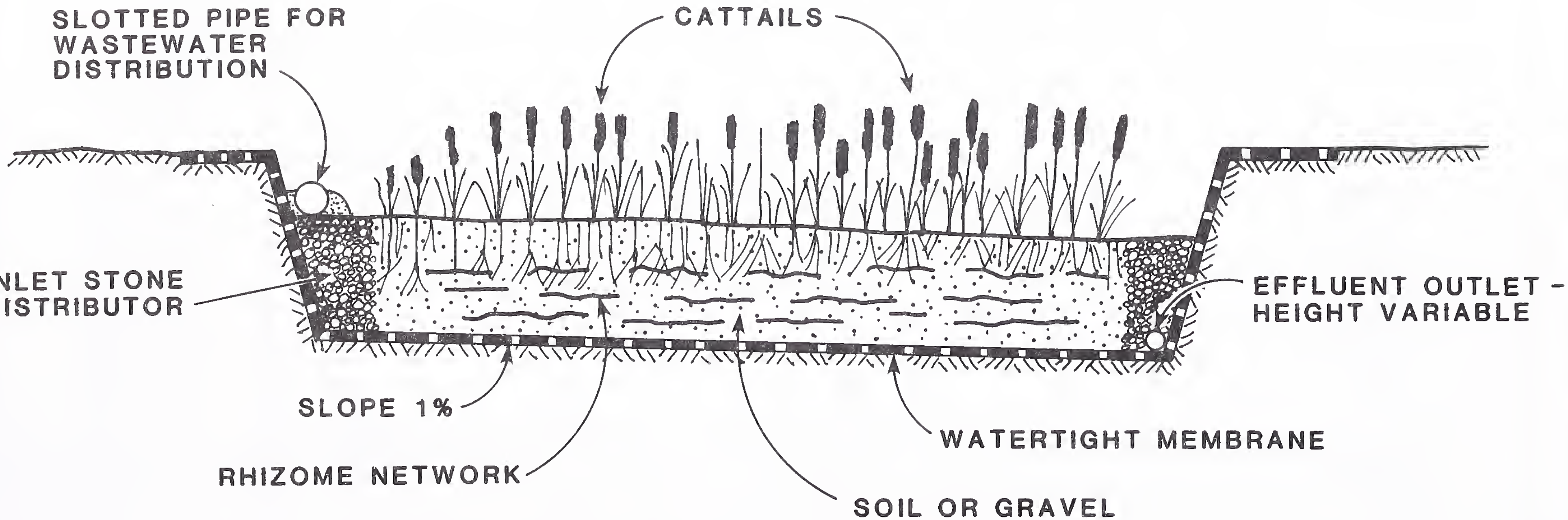
Sources:
(1) Dornbush, J.N. 1988.
(2) O'Neail, T. 1990. Resource Conservation Company. Bellevue, WA. pers. comm. w/ M. Spratt, 4/6/90.
(3) Tininenko, C.R. et al. 1987.
(4) U.S. EPA. 1988a.
(5) Watson, J.T. et al. 1988.
(6) Wildeman, T.R. and L.S. Laudon. 1988.
(7) Daukas, P. et al. 1988.
(8) Johnson, D. 1990. Johnson Systems, Inc. Aurora, IL. pers. comm. w/ M. Spratt, 6/8/90.



Source: IMS, Inc. 1990.

FIGURE 2-21.

GENERALIZED WETLANDS PROCESS



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Source: IMS, Inc. 1990.

FIGURE 2-22.

CROSS-SECTION OF WETLAND CELL

be collected at the outlet channel which would be filled with coarse gravel and discharged to surface water. A Montana Pollutant Discharge Elimination System (MPDES) permit would be required.

Research conducted by the Colorado Department of Health (D. Holm, Colorado Dept. of Health, pers. comm. April 15, 1990 w/ R. Overton) at a number of projects at high altitude mines indicate the three critical elements to efficient metals removal in wetlands are—

- residence time of water in the system (how long it takes for discharged water to move through the wetlands);
- influent water quality (alkalinity); and
- metals content of source organic material or geologic materials used in initial wetlands construction.

Based on available performance data, the residence time should be at least five days. Removal efficiencies are highly dependent on water pH. If water becomes acidic (pH less than 5), certain fractions of organics would disperse and metal adsorption rates would decrease. It has been proposed that effluent from the Pennsylvania Mine in Colorado, located at 11,500 feet elevation, be treated with a wetland system. Preliminary tests at this site demonstrated that the optimum removal of metals was obtained when the pH level was 7 or above (D. Holm, Colorado Dept. of Health, pers. comm. April 15, 1990 w/ R. Overton). Removal efficiencies of metals also generally increase as iron and manganese are removed.

Plant density can also affect removal rates. Plant density can be significantly increased in first year operation by increasing planting density. High rates of metals removal have been achieved with plant densities of less than 35 percent of the wetland.

Operation of the facility would be generally maintenance-free. Some supervision of flow rates and adjustment of water pH would be required. The vegetation may require replacement as it becomes saturated with metals; the saturation period, however, is not predictable based on available data. The replacement period is greater than three years based on other active facilities.

To facilitate maximum root development and maximize treatment efficiency, the wetland would need to be drained in early fall during the first two years of operation. To allow for fall drainage the first two years of wetlands operation, additional treatment capacity would be required.

Treatment cost. The cost of a system designed to treat 950 gpm of mine and adit discharge is estimated to range between $2 to $4 million depending on construction details. Annual maintenance costs have been low for existing systems.

Waste generation. No wastes regulated under the provisions of the Resource Conservation and Recovery Act would be generated.

Method advantages/disadvantages. System advantages include—

- system would be passive; no energy or active management is required for day-to-day operation;
- system would have low installation and maintenance costs compared to the two mechanical treatment systems; and
- system would create wildlife habitat using native plants.

System disadvantages include—

- system would operate at less than optimum removal efficiency for first two years;
- some uncertainty exists on removal efficiencies at very low concentrations;
- wetlands would require draining in the fall of the first two years to promote rooting. Additional water holding or treating capacity would be required;
- addition of treatment capacity would require two year lead time once construction is approved; and
- would disturb the greatest amount of land area.

Evaporator

System description. This system would consist of a vertical tube, falling film evaporator designed to treat wastewater contaminated with inorganic compounds. Treated water would be recovered from the waste stream reducing the final volume of discharged water to about one percent of the original volume. The treated water system would be constructed near the tailings impoundment and treated water discharged to Libby Creek. A MPDES permit would be required. The concentrated waste water would be collected in a small solar pond and evaporated or sent to a dryer and evaporated. A small quantity of metal salts as a solid would accumulate either in the pond or in the dryer.

A modular equipment configuration would be used, providing flexibility in equipment location, rapid installation and the potential for quickly increasing treatment capacity. Individual modules would be skid-mounted units having a treatment capacity of 150 gpm. Seven 150 gpm modules would be required on a short-term basis (two years during construction). Required treatment capacity for tailings seepage would slowly increase of the life of the project; two 150-gpm modules would be required in Year 16 of operations.

Essential equipment would include a concentrator and spray dryer (Figure 2-23). Space required for seven 150 gpm module would be about 21,000 square feet (ft^2). The maximum height of the concentrator would be 56 feet.

The equipment modules would be installed at the tailings impoundment. Based on performance of operating systems, 80 KWH/1,000 gallons of water would be required to operate the evaporator. Equipment operation generally would be automated, requiring about two man-hours per shift (150 gpm module) to perform routine process monitoring and maintenance. An annual shutdown of approximately 10 days for routine maintenance would be recommended.

System process. The treatment process flow would start with a feed tank requiring a pH of 5.5 and 6.0 for deaeration and decarbonation (Figure 2-23). The acidified wastewater would be pumped through a heat exchanger to raise the water temperature to the boiling point. After the feed tank, the wastewater would pass through a deaerator, removing non-condensable gases.

From the deaerator, the wastewater would be fed to a sump and combined with a brine slurry. The brine slurry would be constantly circulated from the sump to a floodbox at the top of a bundle of heat transfer tubes. Some of the brine would evaporate as it flows in a falling film down through the tubes and back into the sump.

The vapor from the heat transfer tubes would pass through mist eliminators and would enter the vapor compressor, which would heat the vapor slightly. Compressed vapor would flow to the outside of the heat transfer tubes. Heat from the compressed vapor would be transferred to the cooler brine falling inside the tubes. The evaporation of the brine would produce clean water.

The waste brine could be sent to a solar pond for evaporation. As an alternative to the solar pond, the concentrated wastewater could be processed into dry solids with a spray dryer. The facilities could be powered by electricity or propane.

Due to the nature of the process, nearly complete loss of ammonia would be expected. Nitrate and ammonia removal would require further evaluation during final equipment design.

Treatment cost. Based on conceptual information, the cost of an installed 300 gpm system for during operations is estimated as $3.8 million. Estimated annual maintenance costs are $96,000 for a 300 gpm system. Detailed design would result in revision of these conceptual cost estimates. Power costs are estimated to be $0.66 million at 300 gpm discharge. Treatment costs for treatment of 950 gpm of mine and adit discharge would be proportional; seven

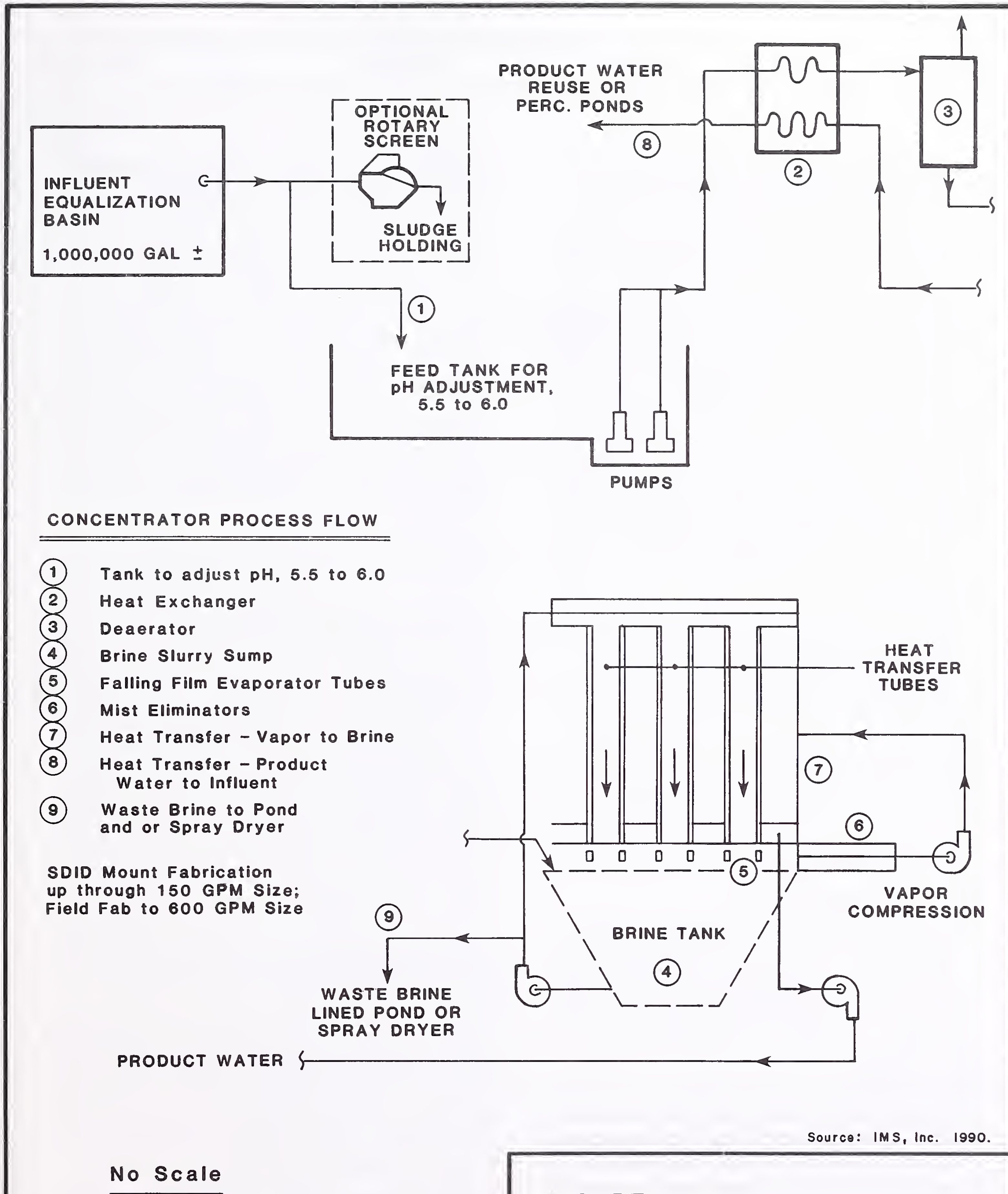


FIGURE 2-23.

GENERALIZED EVAPORATOR PROCESS

modules would cost about $13.3 million with annual electrical costs estimated to be about $2 million.

Waste generation. At the design flow of 950 gpm, the waste stream flow rate would be about 0.9 gpm. The waste stream could be discharged to an evaporation pond or processed with a spray dryer to produce a solid for storage in an approved landfill. At the design flow of 950 gpm, a spray dryer would produce about 400 tons per year of solids. Although any solids produced by this method would not be a listed hazardous waste under the provisions of the Resource Conservation and Recovery Act, the solid may exhibit characteristics of hazardous waste and may require storage at an approved hazardous waste landfill. Tests would have to be conducted on the waste to determine if it would be a hazardous waste.

Method advantages/disadvantages. System advantages include—

- System would achieve the best quality of discharged water of the three systems considered;
- Operation and maintenance of the equipment is not complicated;
- Maximum treatment efficiency would be achieved within 30 days of startup;
- Less land area would be disturbed than with wetlands; and
- Has the longest use history with the best defined performance characteristics.

System disadvantages include—

- Equipment would be the most expensive to purchase and operate of the three treatment methods; and
- System would require active maintenance after mine closure.

Electrocoagulation

An electrocoagulation system would be a mechanical system. It would have removal efficiencies similar to a wetland and would be less expensive than an evaporator system. The system would be capable of effectively removing minerals, suspended minerals and organics, and bacteria from discharged water.

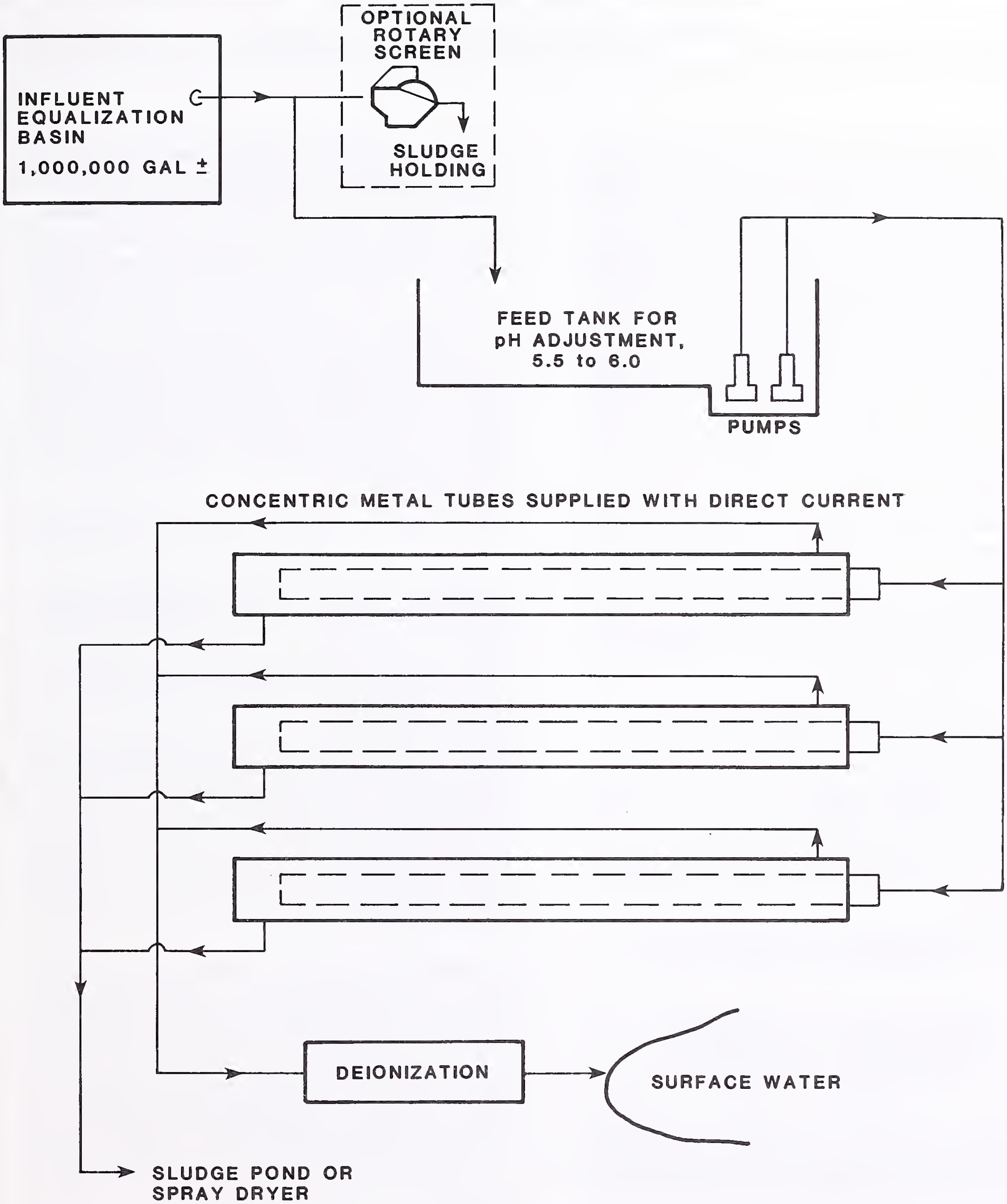
System description. A modular design would be used. Each module would be skid mounted with a treatment capacity of 150 gpm. At design capacity, two modules would be needed to treat tailings water with seven modules needed for mine and adit discharge. The building for a 950 gpm treatment system would be about 1,050 ft^2 with a maximum height of 8.5 feet. The design life of this equipment would be about 20 years. This system would require 30 KWH/1,000 gallons of treated water. Operation of the equipment would be generally automated, requiring minimal staff oversight. Routine maintenance would be minimal.

System process. The treatment process flow would start with collection of the discharged water, screening, and pH adjustment (Figure 2-24). The water then would flow through reactor tubes and then would flow to a clarifier where the solids would be removed. The metals would form a sludge of crystalline solids. The final step in the process would be deionization of the treated water, further nitrate reduction, if necessary, and discharge to surface water. A MPDES permit would be required. Various metals may be used for either tube. Tested tube metals include iron, aluminum, copper, titanium and graphite. The equipment configuration for the process would be a feed tank, reactor tube building, clarifier, sludge holding facility and storage ponds.

Treatment site location. As with the evaporator system, electrocoagulation treatment facilities would be constructed near the tailings impoundment.

Treatment cost. The cost of an installed 300 gpm system would be about $1.6 million. To treat 950 gpm, the installed cost would be approximately $5.6 million. Annual maintenance costs are estimated as $16,000 for a 300 gpm system and $56,000 for 950 gpm system. Power costs are estimated to be $788,000 per year at the design flow of 950 gpm.

Waste generation. Sludge accumulation generally would occur at a rate of 0.01 percent of the volume



Source: IMS, Inc. 1990.

No Scale

FIGURE 2-24.

GENERALIZED ELECTROCOAGULATION PROCESS

treated. Due to the low levels of total dissolved solids in the discharged water, the sludge accumulation rate would be expected to be significantly less. At 950 gpm, this method will produce approximately 400 tons per year of solids. Although any solids produced by this method would not be a listed hazardous waste under the provisions of the Resource Conservation and Recovery Act, the waste solid may exhibit characteristics of hazardous waste and may require storage at an approved hazardous waste landfill. Tests would have to be conducted on the waste to determine if it would be a hazardous waste.

Method advantages/disadvantages. System advantages include—

- Equipment requires minimal operation and maintenance;
- Maximum treatment efficiency will be achieved within 30 days of startup;
- Less costly than evaporator; and
- Least amount of land disturbance of these three treatment methods.

System disadvantages include—

- Equipment is more expensive than wetlands;
- System would require active maintenance after mine closure; and
- Has the least performance record of the three treatment alternatives.

ALTERNATIVE 4–NORANDA'S TRANSMISSION LINE PROPOSAL WITH MODIFICATIONS

This alternative includes modifications to Noranda's transmission line proposal. This alternative could be selected with either Alternative 2 or Alternative 3. Adjustments to the line near the Libby Creek Recreation Gold Panning Area would be made (Figure 2-13). Alternative 4 also includes construction and operation of the transmission line using methods described in Alternative 1 with the following modifications.

Noranda would use a helicopter rather than a crawler tractor during initial transmission line construction operations to string the ground wire and transmission line conductors. Conventional equipment and access roads would be used for other line construction operations. Using a helicopter also would eliminate the need to construct an access road down the center of the transmission line right-of-way and on sideslopes greater than 10 percent, which would be required if the stringing were done as proposed by Noranda. Decreased surface disturbance would reduce impacts to wildlife, visual, soils and vegetation resources.

Timing restrictions would be placed during the fall and winter on transmission line construction activities occurring on big game winter range. Construction would not be allowed between December 1 and March 31, although waivers could be allowed if animals were not present and using the area. This measure would reduce impacts to big game, particularly elk.

Access for line construction and maintenance would be designed to avoid the construction of loop roads to connect with existing road systems. A road management and access agreement also would be developed by Noranda and the agencies. This measure would reduce impacts to big game, particularly elk.

The monopole steel towers used for the line would be treated or painted a darker non-reflective color. Non-reflective static wire and electrical conductors would be used for the entire length of the line. A non-ceramic insulator is recommended for the entire length of the line. If ceramic insulators are used, the color should be brown. Clear glass insulators would not be used. These measures would reduce contrast and visibility of the line from sensitive viewing locations.

In viewer-sensitive locations identified by the agencies (U.S. 2 corridor and Libby Creek area), taller than standard poles may be required to reduce clearing needed for safe operation of the line.

Recommendations for taller poles would be made on a case-by-case basis by weighing the visual or other environmental advantages against the costs of taller poles. This measure would reduce right-of-way clearing and contrast of the line from sensitive viewing locations.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 357 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 5–NORTH MILLER CREEK ALTERNATIVE TRANSMISSION LINE ROUTING

Alternative 5 would realign the transmission line route from the upper Miller Creek drainage to the mouth of Ramsey Creek (Figure 2-13). This alternative could be selected with either Alternative 2 or Alternative 3. Alternative 5 includes construction and operation of the transmission line using methods described in Alternative 1, except the modifications described in Alternative 4 would be incorporated. The impacts of Alternative 5 are compared with those of other transmission line routing alternatives in Chapter 4.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 218 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 6–SWAMP CREEK ALTERNATIVE TRANSMISSION LINE ROUTING

Alternative 6 would realign the transmission line route from the Fisher River to the mouth of Ramsey Creek (Figure 2-13). This alternative could be selected with either Alternative 2 or Alternative 3. Alternative 6 includes construction and operation of the transmission line using methods described in Alternative 1, except the modifications described in Alternative 4 would be incorporated. Since no big game winter range would be crossed by this alternative, timing restrictions during the fall and winter would not be required. The impacts of Alternative 6 are compared with those of other transmission line routing alternatives in Chapter 4.

Areas crossed by this alternative classified as corridor avoidance areas would require an amendment to the Forest Plan. Such areas, totalling 236 acres, would be amended to Management Area 23. Management areas are discussed in greater detail in Chapter 3, Kootenai National Forest Management, and in Chapter 4. The goals and objectives of Management Area 23 are presented in Appendix E.

ALTERNATIVE 7—NO ACTION

Under this alternative, Noranda would not develop the Montanore Project. The environmental, social, and economic conditions described in Chapter 3 of this EIS would not be affected by the construction and operation of the Montanore Project.

ALTERNATIVES CONSIDERED BUT DISMISSED IN THIS EIS

The scoping process identified a number of alternatives determined by the agencies to be infeasible or otherwise unreasonable. The alternatives described in this section have been dismissed from further consideration. The reasons for dismissal are described in the following sections. The identification of these alternatives is the result of a sequence of alternatives analysis efforts, including the Kootenai National Forest's Mineral Activity Report (the MAC Report) on mineral activity in the Cabinet Mountains (Kootenai National Forest, 1986), analyses conducted by Noranda as part of the

project planning process, and agency evaluation during the scoping of this EIS.

The dismissed alternatives fall into seven categories. The separation of alternatives is somewhat artificial, since many—even between categories—are interrelated. The categories are—

- siting of surface mine facilities;
- power supply sources and transmission line routings;
- transmission line construction methods;
- tailings embankment construction methods;
- tailings storage techniques;
- seepage control techniques; and
- joint venture mineral development.

The following is a more detailed discussion of the dismissed alternatives.

Siting of Surface Mine Facilities

The primary objective of the MAC Report was to identify reasonable alternatives for locating various facilities associated with ASARCO's proposed project and other anticipated mining operations, including Noranda's. The MAC Report discusses alternatives for locating project facilities on the east and west sides of the Cabinet Mountains Wilderness. A number of preferred alternatives were identified in the Rock Creek drainage. Alternatives in the Libby Creek drainage were less desirable from a resource management standpoint; recreation, wildlife and visual impacts were the primary concerns (Kootenai National Forest, 1986).

Tailings impoundment sites. Noranda considered 15 alternative tailings impoundment sites (Morrison-Knudsen Engineers, Inc., 1988) and conducted preliminary geologic and geotechnical investigations on three sites (Morrison-Knudsen Engineers, Inc., 1989b). The sites chosen for more detailed investigations were Midas Creek, Poorman Creek, and Little Cherry Creek. The MAC Report also identified and evaluated impoundment sites in Little Cherry Creek and Midas Creek. Criteria used by Noranda for site selection included—

- sufficient tailings storage capacity;
- geotechnical characteristics, particularly consideration of subsurface seepage;
- watershed area and diversion requirements; and
- embankment volume.

The agencies independently reviewed tailings impoundment locations. Site characteristics are described briefly in the following sections. Based on the 1988 investigation, all three sites had adequate storage capacity. More detailed mapping conducted as part of the 1989 study indicated the Poorman Creek site had inadequate storage capacity (about 70 million tons or a 9-year storage life). Construction of an additional impoundment would be required if the Poorman Creek site were used since Noranda anticipates producing 100 million tons of tailings. The Little Cherry Creek and Midas Creek sites have a storage capacity of 120 million tons (16-year storage life) (Morrison-Knudsen Engineers, 1989b). The Poorman site was dismissed from further consideration on the basis of inadequate storage capacity.

The Little Cherry Creek and Midas Creek sites would require the construction of a stream diversion to channel the stream flows around the impoundment. Since a diversion would necessarily be permanent, diversion requirements were a critical factor in site selection. Diversion requirements are directly related to watershed size—smaller watersheds require smaller diversions.

The Midas Creek site has a watershed area (2,430 acres) over twice as large as that at Little Cherry Creek (1,138 acres) (Morrison-Knudsen Engineers, 1989b). The topography of Midas Creek is very steep. Midas Creek would require two diversions (one on each side of the creek) to convey estimated flood volumes. Diversion channels at the Midas Creek impoundment site would be susceptible to possible obstruction by landslides or debris falling from the steep slopes above likely channel

alignments. Channel obstruction could have serious effects on dam stability. If the obstruction was sufficiently large, water to be diverted would flow across the top of the tailings impoundment and down the face of the dam. Severe gullying and subsequent dam instability would result. The dam would ultimately fail if sufficient erosion occurred. Midas Creek site was dismissed on the basis of diversion requirements.

Differences exist in seepage rates from the proposed tailings ponds. Seepage is related to the permeability and thickness of underlying materials, to the pond surface area, and to the physical characteristics of the impounded tailings. The tailings pond area of the Little Cherry Creek site would be slightly larger than that of the Midas Creek site (445 acres versus 370 acres) (Morrison-Knudsen Engineers, 1989b). Subsurface seepage rates would be greater for the Little Cherry Creek, due to greater depth to bedrock at the Little Cherry Creek site and less permeable soils at the Midas Creek site. Both sites, however, would exhibit some seepage, since both are underlain by thick layers of alluvial materials. Long-term effects on water quality in the downstream watersheds would differ only slightly for any of the alternative sites considered.

The Midas Creek and Little Cherry Creek sites would require similar total dam volumes over the life of the impoundment. Approximately 1.76 million cubic yards per year of coarse tailings would be available for construction of the tailings embankment by the downstream method (Morrison-Knudsen Engineers, 1989b); the balance of the required dam material must come from borrow of surface soils within the project area or from mine waste rock. The diversion channel at Little Cherry Creek and Midas Creek sites would provide the necessary materials.

In summary, no alternative tailings impoundment site offered significant environmental advantages over Noranda's proposed site. Midas Creek was not considered because of the large watershed area and resultant large diversion requirement. The Midas Creek diversion would be subject to greater risk of obstruction and subsequent dam instability or failure. The Poorman Creek site was dismissed on the basis of inadequate capacity.

Plant sites. Three plant site alternatives were considered during the scoping process. The alternatives considered were—

- Libby Creek at the adit location;
- Little Cherry Creek near the tailings impoundment; and
- Ramsey Creek downstream from the proposed plant site location.

Alternatives to Noranda's proposed plant site were dismissed for a variety of reasons. A site near the Libby Creek evaluation adit was rejected because of a higher avalanche hazard and greater potential impacts to the grizzly bear. (see Figure 3-5 in the following chapter.) Of the three alternative plant sites considered, the Libby Creek site had the highest habitat value for the grizzly bear.

A site location near the proposed tailings impoundment would reduce both visual impacts to the Cabinet Mountain Wilderness and wildlife impacts in the Ramsey Creek drainage. This location was dismissed primarily because of cost and safety considerations. It would require the construction of a conveyor to move ore and waste rock from the mine to the plant and tailings impoundment, greatly increasing capital and operating costs. Higher labor costs would be incurred by transporting workers from a plant site at Little Cherry Creek to the mine. Management of underground operations would be more difficult from a Little Cherry Creek site—response to situations underground would be slower.

Locations in Ramsey Creek downstream of the proposed site were considered and dismissed. Impacts to most environmental resources would be similar to the proposed location. Visual impacts would be reduced somewhat with increasing distance downstream, but construction and operating costs would be increased. A longer adit would be

necessary to reach the ore body, generating more waste rock. Because worker transportation time would be greater, a longer adit would decrease production efficiencies and increase labor costs. Capital and operating costs would be higher.

Power Supply Sources and Transmission Line Routings

Several sources of power and different powerline designs, construction methods, and locations were considered for the proposed mine. Two alternatives were eliminated from consideration early due to their excessive costs and infeasibility. Four other alternatives were evaluated further by Noranda and the agencies, but were ultimately eliminated because they were more costly and did not offer any advantages over the alternatives retained for further study. The alternatives dropped are discussed below.

Mine site generation. Noranda investigated and eliminated the possibility of on-site electrical generation to supply the mine's power needs on a sustained basis. This option would require a gas-fired electric generating plant capable of producing about 55 megawatt (Mw), and a new 40-mile natural gas pipeline to the mine from an existing Pacific Gas pipeline. Capital costs for construction of the generating plant and the new pipeline were estimated at $35 million. Operation and maintenance costs associated with this option would be higher than those involving electricity generated elsewhere and brought to the mine by transmission lines. Noranda and the agencies independently eliminated this option because of high capital costs and the likelihood of additional costs to address environmental considerations such as air quality.

Underground construction. Noranda investigated an option for providing power from Noxon Rapids Dam to the mine site via an underground adit beneath the Cabinet Mountains. This alternative would either tap into the 115-kV system at the Noxon switchyard near the Noxon Rapids Dam or it would connect with the Noxon-Libby 230-kV line where it passes by Noxon Rapids Dam. From the connection point, overhead lines would be built up the Rock Creek drainage for approximately 8.5 miles to a transformation substation built near Rock Lake. The substation would lower the voltage to a level that an underground cable system could carry. Cables installed in a mine adit would extend from Rock Lake underground to the Ramsey Creek plant site. Power would be distributed to the mill and mine complex from Ramsey Creek. The distance from the Noxon site to the Ramsey Creek site is approximately 15.1 miles including 6.4 miles of underground construction. This alternative was initially considered in order to take advantage of a ventilation adit proposed by Noranda in the upper Rock Creek drainage. Noranda has since eliminated the Rock Creek adit from its mine plan, making this alternative infeasible for the following reasons.

Several technical and cost factors weigh against further consideration of underground construction. Underground power from the west side of the Cabinet Mountains would require construction of an adit at a cost between $20 and $30 million. Underground cable and associated equipment installation could add another $30 million. High voltage transmission is not technically practical underground because it requires more sophisticated and expensive conductor technology. The only option for underground transmission is to reduce the voltage. A lower voltage level is not practical because of the type of loads anticipated at the Ramsey Creek plant site. Mine loads would not be adequately served by a cost effective and reliable underground system. Operating costs would be substantially increased by power losses incurred in the voltage transformation and in-line losses between Rock Lake and Ramsey Creek. Increased maintenance, decreased reliability and greater costs to locate and repair underground cable failures also weigh against this option when compared to overhead construction.

Power sources and routing options. Several power sources on the east side of the Cabinet Mountains

were considered to serve the mine. One source would require a new line to the mine from a substation located just north of the town of Libby. The substation is owned by Pacific Power and Light Company, and supplied by a 115-kV line jointly owned by BPA and Pacific Power. Power is supplied by Libby Dam. The Libby Creek route is approximately 26 miles long. The transmission line from the substation to the mine would follow south along Libby Creek, passing on the east side of the town of Libby (Figure 2-13). The line generally would follow U.S. 2 and Libby Creek for about 12 miles, turning southwest and generally following USFS Road 231 along Libby Creek. Near the confluence of Libby and Poorman creeks, the route would angle southwest to the mouth of the Ramsey Creek and continue west up the drainage to the plant site.

Computer analysis by Pacific Power and the BPA indicated electrical problems would result if Montanore Project loads were connected at the Libby substation. Connection to the mine would cause low voltage and thermal overload problems to electrical systems in northwest Montana and north Idaho, and costly upgrades would be necessary to provide adequate and reliable power to the mine and other service areas. The transmission line capacity from Libby Dam to the Libby substation over the existing 115-kV line is too small to supply adequately the mine and existing loads under certain outage conditions. As loads grow in the area, these conditions would only worsen if the 115-kV system were used. Approximately 12 miles of 115-kV line from Libby Dam to Libby would have to be upgraded to enable the Libby substation to supply power to the mine, and an existing 115-kV/230-kV transformer at Libby Dam substation would have to be upgraded. Noranda would have to pay the construction cost.

The primary advantage of the Libby Creek route is that it would follow existing transportation and transmission line routes over much of its length. In addition to power supply problems, the major disadvantages of the Libby Creek route are that construction costs would be nearly twice that of several other routes; operating costs would be substantially higher than several other routes; and all potential route alignments would pass through and adjacent to a much higher population density, affecting substantially more private land than other routes. There are an estimated 675 dwellings within one mile of its corridor (Noranda Minerals Corp., 1989c).

Supply options dismissed. A number of options for tapping the area's 230-kV system were evaluated. Noranda's loads could be served by a 115-kV line connected to the existing 230-kV transmission system. However, the additional transformers required to convert from 230-kV to 115-kV would make this option more expensive. The power lost in overcoming the line's resistance would be four times higher at the lower voltage, increasing power losses and operating costs. Noranda therefore selected 230-kV as the preferred voltage to serve the mine.

Noranda considered a tap on the Noxon-Libby 230-kV line seven miles southwest of Pleasant Valley, Montana. This alternative, referred to as Trail Creek, would require a substation tap on the BPA line in a remote area near the junction of Iron Meadow Creek and the Silver Butte Fisher River (T26N, R30W, Section 33). This remote substation location was unacceptable because there is no road to the site and facilities of this size are normally inspected at least once a month, with continuous access to the substation required for equipment repairs or line switching. Use of this remote site would require either costly road maintenance or less reliable service to the mine.

A transmission line from this site to the mine site would cross remote areas (Figure 2-3). From the substation, the line would follow north along Iron Meadow Creek to its headwaters, where it would cross the divide into the Trail Creek drainage. The line would follow Trail Creek north to its confluence with West Fisher Creek. It would then proceed northwesterly along West Fisher Creek and one of its tributaries, Standard Creek, crossing over the divide

into the Libby Creek drainage. The line would pass east of Howard Lake, continue in a northwesterly direction across Libby Creek, and turn west along Ramsey Creek to the mine site. The main advantage of the Trail Creek alternative is its relative shortness (approximately 16 miles). Disadvantages of this corridor include crossing areas managed as roadless and other sensitive USFS land management units (e.g., recreation areas and grizzly bear habitat). This corridor would require relatively extensive clearing and road building. This routing was not retained by the agencies for further detailed study because it does not offer environmental advantages and may have higher potential environmental impacts.

Five alternative routings for the line were evaluated from a proposed tap site on BPA's Noxon-Libby 230-kV line at Sedlak Park west of Pleasant Valley. Three of the alternatives, the proposed action with mitigation (Alternative 4), Alternative 5, and Alternative 6, are discussed in detail in Chapter 4. Two additional routing alternatives were eliminated from detailed consideration because they offered no significant advantages to cost or the environment over the alternatives carried forward for detailed agency review. The two routes eliminated were West Fisher Creek and Miller Creek/Midas Creek options.

The West Fisher Creek route would follow the Fisher River north from the Pleasant Valley intertie site to the confluence with West Fisher Creek, and then would proceed west along West Fisher Creek to near its confluence with Standard Creek (Figure 2-3). The corridor then would proceed north-northwesterly over the divide into the Libby Creek drainage past Howard Lake, and then west along Ramsey Creek to the mine site. The West Fisher alternative is 19.4 miles long. It generally would follow existing roads and would be located at relatively low elevations, providing some advantage for line construction and maintenance. It would be longer than other routes and would cost more. The West Fisher alternative would affect more private landowners than other 230-kV alternatives. It also would affect more national forest users due to its location along a major forest access route.

The Miller Creek/Midas Creek corridor would follow the Fisher River valley from the substation north for four miles, turning west along Miller Creek (Figure 2-3). The route would follow Miller Creek about four miles, and then would turn northwest along an unnamed tributary to Miller Creek. The route would cross the divide into the Midas Creek drainage and follow the east side of this drainage for about three miles, then would turn west, crossing Libby Creek about one mile below the mouth of Poorman Creek. After crossing Libby Creek, the route would turn southwest toward the Ramsey Creek drainage and follow that drainage to the mine site. The route would be about 18.2 miles long. Its increased length avoids private property along Libby Creek. Because of the greater length of this option and the lack of environmental advantages over other alternatives, the agencies dropped this alternative from further consideration.

Line Transmission Construction Methods

H-Frame wood poles. The preferred structures to support the conductors are 95-foot steel monopoles. H-frame structures were considered and comparative information, when appropriate, was included in the transmission line application (Noranda Minerals Corp., 1989c). The primary reason for choosing the monopole over H-frame structures is that right-of-way and clearing widths would be less with monopoles. Also, steel monopoles would require less maintenance during operation and can be purchased in an assortment of colors, which may ease the visual impact of the transmission line. Although the cost of steel monopoles over H-frame wood structures would be approximately $5,000 per mile more, Noranda and the agencies concluded that the overall environmental impact would be less for steel monopoles.

Helicopter construction. The use of helicopters to erect the transmission line was considered as an

alternative to conventional construction methods. The agencies determined that general use of helicopters in line construction would have little environmental advantage since conventional equipment (such as augers) would be required to excavate foundations for the transmission line poles. Disturbance associated with access required to move this equipment to each pole location could not be avoided unless more expensive and time-consuming methods (such as hand digging of pole foundation holes) were done. Line maintenance would also require ground access to each tower. For these reasons, the agencies dismissed this method as a recommended line construction alternative, recognizing that using helicopters could be left to the discretion of the construction contractor.

Tailings Embankment Construction Methods

Tailings impoundment dams typically consist of raised embankments, constructed incrementally over the life of the impoundment. Raised embankments usually begin with a starter dike constructed of compacted fill and sized to store one to three years of tailings production. Subsequent incremental embankment raises are staged to keep pace with the dam height required for tailings output. Raised embankments, regardless of the construction materials, generally fall into one of three categories: upstream, downstream and centerline embankments. These categories refer to the direction in which the raised embankment moves in relation to its initial starter dike position. Because of a seismic potential in the project area, the agencies considered Noranda's proposed downstream construction method superior to the other two methods. Since alternative construction methods did not offer environmental or technical advantages to the method proposed, none were considered further.

Tailings Disposal Techniques

Underground mine backfilling. Backfilling of tailings into the mine was evaluated to determine whether it could be used to reduce the size of the tailings impoundment, and the consequent amount of seepage associated with the impoundment. Backfilling has traditionally been used in steeply dipping deposits for ground support to minimize ore dilution and to prevent collapse of the workings, and as a platform for miners to reach overlying ore. It has rarely been used for large, gently dipping deposits or simply as a means of tailings disposal.

When rock is broken, crushed, and ground into tailings, it increases in volume. This is referred to as bulking. The effect of bulking is that only a portion of the tailings can be backfilled into the mine. Typical cut-and-fill mining operations replace about one ton of tailings for every two tons of ore mined (Wayment and Cuistar, 1982). The theoretical amount of tailings that could be backfilled into the Montanore Project mine would be slightly higher.

Conventional backfilling operations mix water with the tailings to form a slurry. The slurry backfill is either pumped or gravity-fed into the previously mined areas. Only coarse, sand-sized tailings can be used in order to ensure rapid drainage and consolidation of the backfill. High percentages of fines in the backfill would inhibit this drainage and result in a weak, saturated mass subject to shock loading and fluidization. Estimates based on the expected Montanore mill grind indicate that about 31 percent of the tailings by volume (about 40 percent by weight) might be suitable for conventional backfill. The majority of tailings (slimes) would still require surface storage. The total volume for surface storage would be about 69 percent of total tailings.

A reduction in the amount of tailings requiring surface storage would result in only a minor reduction in the size of the tailings impoundment. It would, however, increase the amount of total surface disturbance. This is because the coarse fraction of the tailings which normally would be used to construct the embankment would instead be going underground as backfill. This would require that approximately 25 million cubic yards of borrow material be mined on the surface for use in

constructing the embankment. The amount of surface disturbance associated with mining this borrow would depend on the specific material and the depth mined. The agencies assumed the replacement material would have an in-place density of 120 pounds per cubic foot and an average borrow depth of 15 feet. Using these assumptions, over 1,000 additional acres would be disturbed.

Conventional backfilling would also require significant changes in the underground operation, and would increase both capital and operating costs. Capital requirements would increase up to 10 percent of planned mine investment and direct mine operating costs might increase by 50 to 100 percent. In addition, the cost to excavate, haul, and place the borrow used for the embankment would be significant. Conventional backfilling was dismissed as an alternative because it would increase the total amount of surface disturbance, and would not be economically feasible.

The only potential for backfilling to reduce surface disturbance would be to use the whole fraction of tailings for backfill. Although all of the tailings would not be able to go back into the mine, use of the whole tailings fraction (fine and coarse grain) would leave some of the coarse tailings for use in embankment construction. This approach would require using high density slurry (dense backfill) containing 80 percent or more solids by weight. Low permeability fine tailings could be included in the backfill because the low water content makes free drainage of the backfill unnecessary. Filtering or decantation and storage in a silo would be required to achieve these densities. No one is currently using this approach in the U.S., or for large stratiform deposits such as the Montanore Project ore body (Boldt, L., U.S. Bureau of Mines, pers. comm. with B. Thompson, KNF). The U.S. Bureau of Mines is currently studying the use of dense backfills, but the method has not been fully developed yet for use in this type of an operation. This alternative was dismissed because it is not a viable technology at this time.

"Dry" storage. Some precious metal mines are using or considering belt filtration (removal of a percentage of liquids) to produce "dry" tailings that can be handled essentially as a solid material. Because of the increased capital and operation costs, filtration is limited to special operating conditions, such as water quality considerations, tailings storage limitations, or reagent recycling (such as cyanide). One mine in Montana, the Jardine Joint Venture project, is currently using dry tailings storage because of water quality concerns. The mine, however, is much smaller than the proposed Montanore Project and the tailings at Jardine Mine have much higher trace metal concentrations (Montana Department of State Lands and Gallatin National Forest, 1986). No mine as large as the proposed Montanore Project is currently using dry storage disposal methods.

In belt filtration, a series of belt filter devices would be constructed to remove water from the tailings as they move across a filter cloth belt. The tailings moisture content would be reduced between 75 and 85 percent. The tailings would come off the belts as a cake and be trucked or conveyed to a disposal site. The disposal site would require an embankment to support the tailings and a seepage collection system to collect drainage. Diversion channels also would be necessary

While technically feasible, the cost of such an approach for a mine the size of the proposed Montanore Project may be prohibitive. It is estimated a 20,000 ton/day operation would cost about $20 to $25 million for the filtration facility and requisite mobile equipment, and could add $1.50 to $2.00 operating costs per ton of ore. Conventional tailings storage system would cost about $0.50 per ton of ore.

This alternative was dismissed because of increased costs and the lack of significant environmental advantages over Noranda's proposal.

Seepage Control Techniques

As discussed in Chapter 1, the Water Quality Bureau of the Montana Department of Health and Environmental Sciences has determined that the Montanore Project would result in degradation of the water quality in Libby Creek. The regulations implementing the "non-degradation" provisions of the Montana Water Quality Act require an analysis of treatment alternatives which would result in less or no degradation. The agencies considered lining the entire impoundment with a synthetic liner to collect tailings water prior to entering soils (and ultimately, the groundwater) beneath the impoundment. This alternative is described in the following section.

Seepage of water from the tailings impoundment could be minimized through the use of a synthetic liner (such as high density polyethylene) or a compacted clay liner over the entire impoundment area. Full lining with synthetics or clay has been employed on several uranium and gold projects (Lubina et al., 1979; Small et al., 1981; McCready, 1989), but have not been applied to any large-tonnage base metal projects. Lining of impoundments at uranium and gold operations is more routinely undertaken because of the deleterious nature of the tailings water quality.

Full lining with a synthetic liner or compacted clay would be feasible at the Little Cherry Creek site. The site has relatively gentle topography and little exposed bedrock within the impoundment area. The impoundment surfaces could be relatively easily prepared to receive synthetic lining, and the gentle slopes and generally granular surface soils would contribute to the stability of the liner on slopes. Placement of a compacted clay liner would be impractical, due to the limited availability of suitable clayey soils in the project area and the increased surface disturbance that would be associated with borrowing of clayey soils.

Potential leakage through a synthetic liner can be due to either permeation (water movement) through an intact liner or leakage through liner defects. Published results of theoretical liner permeation estimates for 80-mil thickness liners (EPA, 1987) indicate maximum steady state flows of about 0.2 gallon per acre per day, or about 89 gallons per day (0.06 gallon per minute) for the 445-acre final pond area at the Little Cherry Creek site.

Recent research (Brown et al., 1987; Giroud and Bonaparte, 1989a, 1989b; Giroud et al., 1989; EPA, 1987) indicates that with intensive quality assurance monitoring, defects in synthetic liners can be limited on the average to one "standard" defect measuring 1/16-inch square inches per acre of liner. Using this standard defect, for a 40-mil thick liner, the estimated leakage rate ranged from about 0.2 to 1.0 gallon per acre per day, depending on the degree of contact between the liner and the compacted subgrade (EPA, 1987). For a fully-lined Little Cherry Creek impoundment, a leakage rate from about 89 to 445 gallons per day (0.06 to 0.31 gallon per minute) is estimated.

In comparison to the 475 gpm seepage projected by Noranda, lining the impoundment would capture nearly all tailings water prior to seepage. The water then would be treated by one of the treatment techniques described in Alternative 3.

The additional cost associated with fully lining the Little Cherry Creek impoundment is estimated to be $26,000.00 per acre, or about $11.6 million for the final impoundment. Increased cost also would be incurred by treating a greater quantity of water. As a result, this alternative would be more expensive than other available alternatives, such as gravel drains described in Alternative 3. Although full lining of the impoundment would reduce the quantity of seepage reaching Libby Creek, water quality would not be significantly improved as compared to Alternative 3. Further, under this alternative, Noranda would still need a waiver of water quality standards from the Board of Health and Environmental Sciences. For these reasons, full

lining of the impoundment was not considered a reasonable alternative.

Joint Venture Mineral Development

Neither ASARCO nor Noranda contemplates entering into a joint venture agreement. Letters were sent to both companies requesting consideration of a joint venture, and both explicitly rejected the idea (ASARCO, Inc., 1988; Noranda Minerals Corp, 1988b). The agencies have no regulatory authority to require a combined operation.

REASONABLY FORESEEABLE ACTIVITIES

Timber

Three timber sales are under contract in the project area (Table 2-10). Approximately 18 million board feet (mmbf) of timber remain to be harvested as part of these sales. In conjunction with these sales, 5.4 miles of new roads will need to be constructed and 1.4 miles of existing roads reconstructed (D. Crawford, Libby District Forester, pers. comm., March, 1990, with R. Trenholme).

During the 10-year planning period, 13 timber sales are planned in the vicinity of the Montanore Project site (Table 2-10; Figure 2-25). Harvested timber volumes are expected to be 33.5 mmbf from 1,675 acres. It is estimated that about 8.4 miles of road would need to be constructed and about 7.9 miles of road reconstructed in conjunction with these timber sales.

Post-harvest activity on each of these sales may

Table 2-10. Current and proposed timber sales in project area.

Sale	Fiscal Year	Volume (mmbf)	Acres	Truck trips	Miles of road work Construction	Reconstruction
Current sales						
Midas	'89-'92	6.2	310	1,240	5.4	0
Hoodoo	'89-'92	6.8	340	1,360	0	1.4
Horse Cable	'89-'91	1.5	75	300	0	0
Proposed sales						
Smearl	'93-'96	1.0	50	200	1.0	1.0
Big Cherry	'93-'96	1.0	50	200	0	1.0
Deep Creek	'94-'97	1.5	75	300	0	0
Hoodoo	'95-'98	2.5	125	500	0	0
Horse Mtn. West	'95-'98	1.0	50	200	0	0
Libby Creek	'96-'99	3.0	150	600	0	0
Standard	'96-'99	1.0	50	200	1.5	1.5
West Fisher	'96-'99	1.0	50	200	0.5	0
Teeters	'96-'99	2.0	100	400	0	3.0
Horse Mtn. East	'97-2000	2.0	100	400	0	0
Trail Creek	'97-2000	.5	25	100	0	0
Misc. salvage and stand tending	'90-2000	2.5	125	500		
Total		33.5	1,675	6,700	8.4	7.9

Source: Libby Ranger District. 10-Year timber sale program.

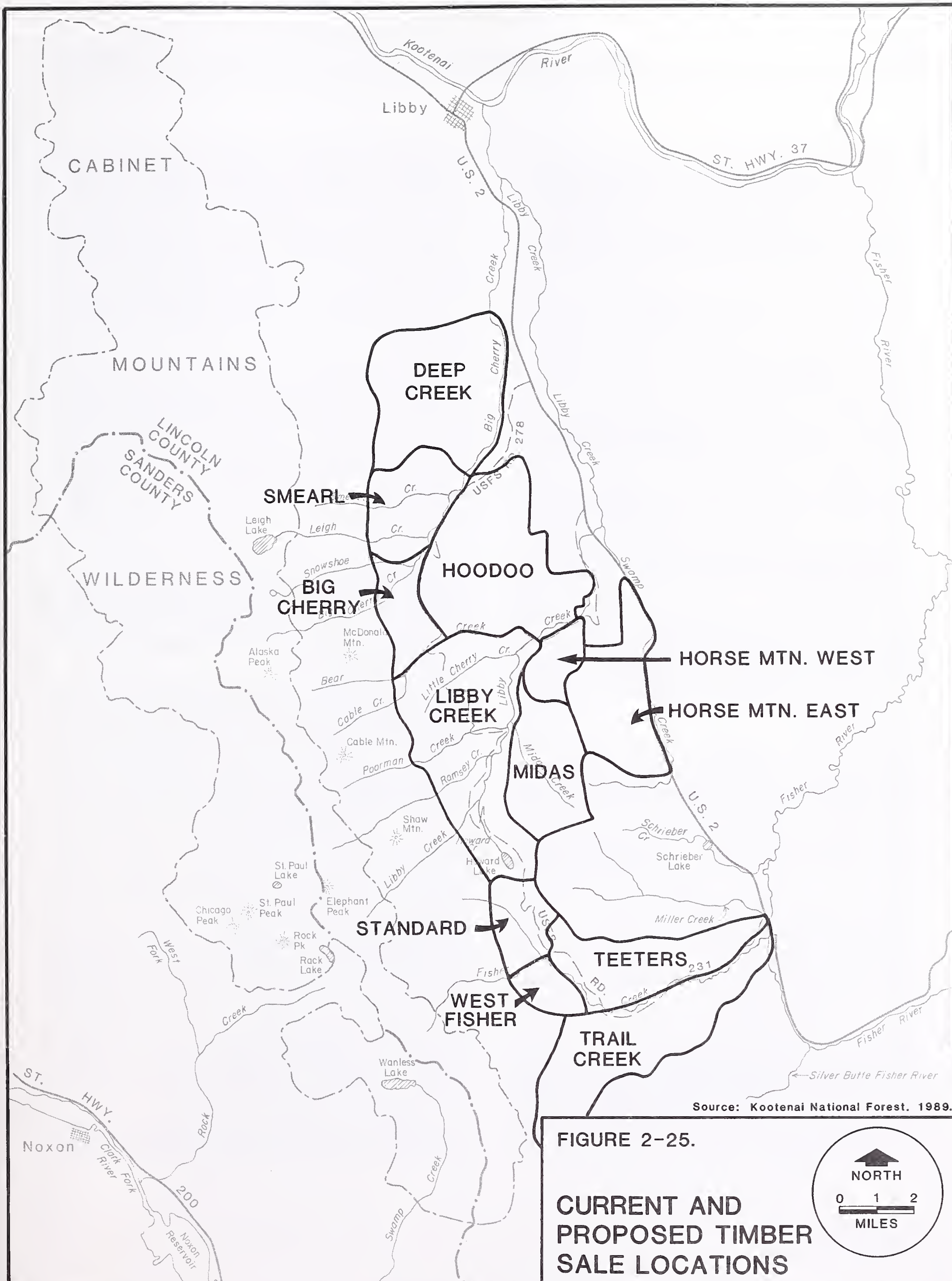


FIGURE 2-25.

CURRENT AND PROPOSED TIMBER SALE LOCATIONS

include the following—

- Ninety percent of the units would be broadcast burned one year after logging to remove slash and prepare areas for forest revegetation. The other 10 percent of the area's slash would be piled by bulldozer and burned.
- Ninety-nine percent of the units would be regenerated by planting bare-root stock.
- All newly constructed roads would be permanently closed. Temporary roads would be seeded to mixed grasses for soil stabilization.
- Regeneration monitoring would be conducted in years 1, 3, and 5 after site preparation. Additional monitoring and/or planting may be needed if initial regeneration is not successful.
- Other possible activities that may occur include: controlled burning to improve wildlife habitat, installation of structures in streams to provide habitat and allow fish passage, and reconstruction of recreation trails.

This information is based on what has occurred in the past on the Libby Ranger District. What would actually occur on each sale cannot be determined until an environmental analysis is conducted.

Mineral Activities

The potential for additional mining and mineral exploration was estimated for the southwest portion of the KNF. The estimate was based on a ten-year forecast period (1990 to 2000). The estimate of reasonably foreseeable mineral activities is based on—

- current and past levels of activity;
- present market conditions;
- submitted operating proposals;
- known ore reserves; and
- the area's mineral potential.

Within the next ten years, the development of two new copper-silver mines (Noranda's Montanore and ASARCO's Rock Creek), possible development of a heap-leach gold mine (Orvana), the closure and reclamation of ASARCO's Troy Mine, and continued exploration for copper-silver and lode gold deposits could occur in the mineral study area. If approved, the ASARCO and Noranda operations could be in full production by 1994 to 1995. Total production from these two mines could be 30,000 tons of ore per day, with about 19 million ounces of silver and 144 million pounds of copper possibly produced each year.

The Troy Mine may exhaust known reserves as early as 1994, corresponding to the possible opening of the Rock Creek and/or the Montanore projects. This closure date might be extended if current exploration in the mine area delineates additional reserves, or if market conditions allow for mining lower grade resources.

It is possible that a heap-leach gold mine could be developed at Orvana's property near Libby. Such development would depend on discoveries made with current exploration drilling activities and the market price of gold. No development plan has been submitted to the agencies.

On average, about ten exploration drilling projects would be conducted each year, nearly all for stratabound deposits. This drilling should focus in areas of current activity. One or two new areas may be drilled each year. Two miles or less of new roads would be constructed or reconstructed each year for exploration drilling. These roads would generally be reclaimed at the end of the drilling operation. The majority of exploration drilling should prove unsuccessful in discovering new ore deposits.

It is possible, based on the area's mineral potential, that a new copper-silver deposit would be discovered within the ten year forecast period. The long lead times necessary to explore and develop such a deposit make it unlikely that a new mine would be constructed within the ten-year period. It is not possible to predict where such a deposit would be located or how it would be developed.

U.S. Borax (now Kennecott) will likely apply for mineral patent of two small copper-silver properties

located in the Cabinet Mountains Wilderness adjacent to ASARCO's Rock Creek deposit. Such patenting, if approved, would retain management of the surface with the U.S. Forest Service. Patenting of these properties would not lead to development of a new mine. The ore reserves are too small to warrant development of a separate mine. Any production from these properties would be in conjunction with either ASARCO's Rock Creek Project or Noranda's Montanore Project. Examinations by the Forest Service of additional claims in the Cabinet Mountains Wilderness could determine some claims had valid mineral discoveries prior to the wilderness withdrawal date of January 1, 1984. It is very unlikely that additional major mine development would be associated with any of these claims. Any development in the wilderness would be subject to agency review and approval.

Weekend prospecting, small scale placer operations, and general assessment work will continue at present levels. Most of these activities will be confined to historic mining districts.

The KNF will continue to sell and provide free permits for existing pits and quarries where sand, gravel, and building stone are now obtained. No major development of construction mineral materials is envisioned for this area, with the exception of borrow material possibly needed for construction of the Montanore or Rock Creek projects.

ASARCO's Rock Creek Project

On May 6, 1987, ASARCO, Inc. submitted an Application for Operating Permit and a Plan of Operation for the development of mineral properties near Noxon, Montana. This project is known as the Rock Creek Project.

The KNF and the DSL began a joint process to analyze the impacts of the operation in a single EIS. The EIS has been postponed while additional baseline data is collected for alternative locations of a tailings impoundment and water disposal areas not considered in the original application. Once the remaining information is submitted and reviewed by the agencies, the EIS will be finalized and made available for public review and comment.

The following is a brief description of ASARCO's proposal. As with this EIS, the Rock Creek EIS will examine reasonable alternatives to ASARCO's proposal and the agencies' preferred alternative may be other than ASARCO's proposal.

General description. ASARCO would construct a 10,000-ton-per-day mine and mill complex to extract copper and silver ore from patented mining claims under and adjacent to the Cabinet Mountains Wilderness, about 13 miles northeast of Noxon, in Sanders County, Montana (Figure 2-26). The project is similar in scope and operation to ASARCO's Troy Mine in Lincoln County, Montana.

ASARCO anticipates a 3.5-year construction and development period, with limited ore production beginning after 2.5 years. Full production would last for about 30 years. The mine life would be dependent upon metal prices, engineering, and other factors that determine economic viability. Post-mining reclamation is estimated to require two years to complete.

Mining would use an underground room-and-pillar method. The on-site ore processing complex would crush and grind ore to liberate metal-bearing sulfides. Sulfides would then be removed by flotation, dewatered, and trucked to the Noxon railroad siding to be shipped to an off-site smelter. Tailings from the ore processing would be deposited in a tailings impoundment north of U.S. 200 near its junction with Rock Creek Road. Additional project facilities would include an access road, utility corridor, surface conveyor, office building, shop, and warehouse.

The proposed permit boundary would encompass 1,972 acres, of which 504 acres would be disturbed and 1,473 would remain undisturbed (Table 2-11). Land encompassed by the permit boundary is 33 percent privately held and 67 percent administered by the Forest Service.

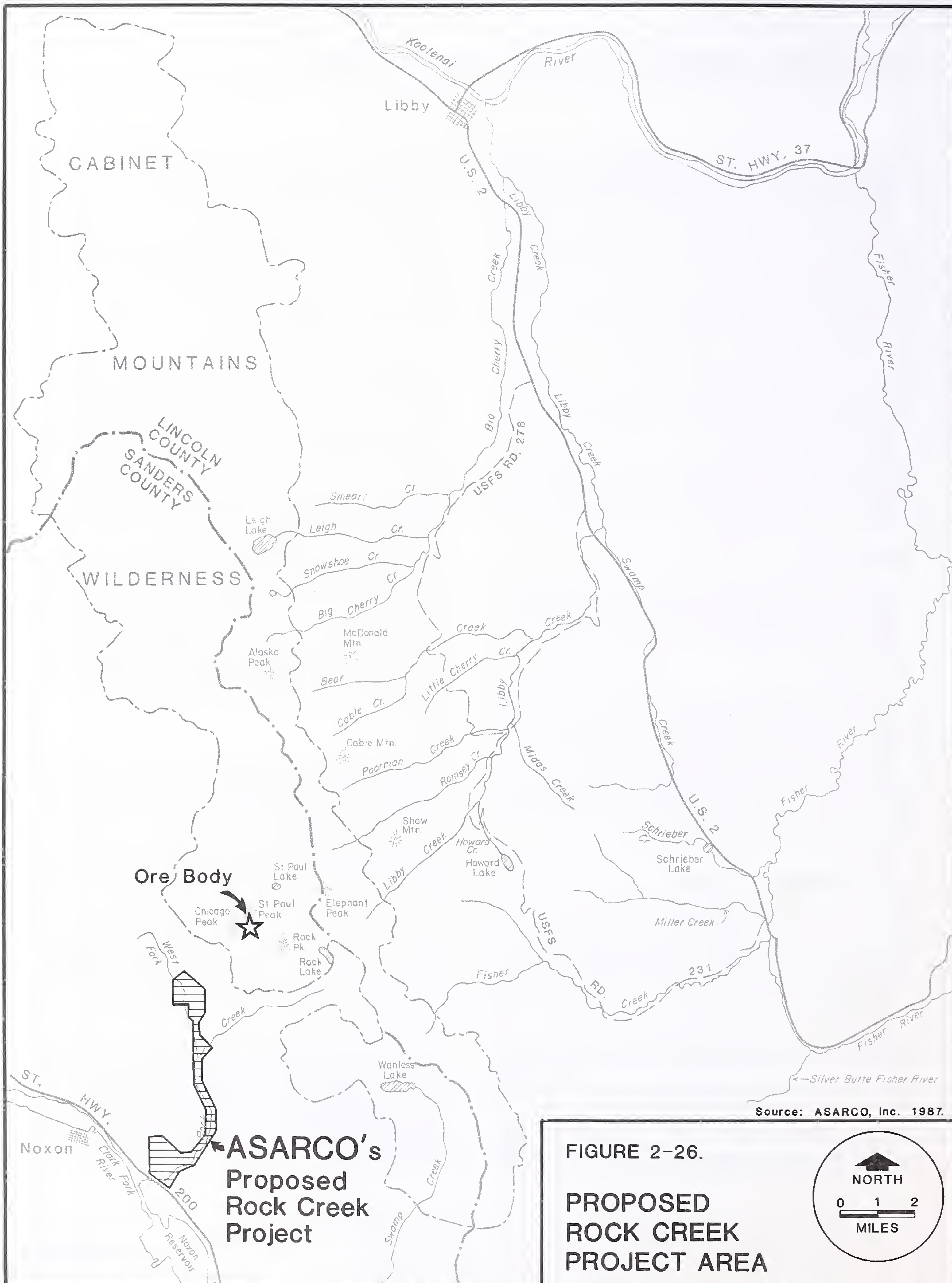


FIGURE 2-26.

PROPOSED ROCK CREEK PROJECT AREA

Table 2-11. Surface area disturbance—ASARCO's Rock Creek Project.

Facility	Acres
Tailings impoundment	396
Access road and utility corridor	33
Plant site area and associated disturbances	50
Mine portal site and associated disturbance	5
Mine access road	10
Waste rock dump	10
Total	504

Source: ASARCO, Inc. 1987. V. 2, Part 1, p. 4

Mine plan. ASARCO would develop an underground mine producing 10,000 tons of ore per day, or 3.6 million tons per year. Current ore reserves are approximately 144 million tons at 1.65 ounces per ton of silver, and 0.68 percent (14 pounds per ton) copper. Overall ore extraction is expected to be 70 percent, giving the mine an anticipated production life of 30 years.

Preproduction development would include drilling two parallel adits directly northeast of the plant site. Adit portals are proposed outside the wilderness boundary. The north adit would be a conveyor adit and the south a service adit for mine access. Small portal patios would be associated with each adit.

A ventilation adit is proposed within the wilderness boundary. The ventilation opening in the wilderness area would disturb less than 800 square feet of surface. Since this opening would be driven from inside the mine to the surface, no waste rock would be deposited on the surface at the opening; the disturbed area would be limited to the opening itself.

Conventional methods of drilling, blasting, rock bolting, and mucking would be used. Broken ore would be reduced by underground crusher and then removed to the surface via conveyor belt for further crushing. A surface conveyor would transport ore from the portal to a mill. Ore mined during the preproduction period would be stockpiled at the plant site for treatment after completion of mill facilities. During preproduction, an estimated 600,000 tons of waste rock would be produced. A portion would be fill for the plant site and the remainder would be dumped in an area below the access road. Waste rock would be stored in previously mined areas during the production period.

Surface disturbance would result from the mine access road, service and conveyor adit portals, waste rock storage area, the plant site area and surface conveyor, tailings impoundment, and utility corridor.

Ore processing and shipment. The ore processing facility would consist of an underground primary crusher, a secondary crushing plant, concentrator, tailings thickener, drainage sumps, pumps, and slurry and water lines. An office building, changing house, and shop warehouse would also be located at the plant site.

The milling process involves six major steps—primary crushing, secondary crushing, grinding, flotation, concentrate dewatering, and tailings storage. Crushing, grinding, and flotation produce both sulfide concentrate and waste tailings. Concentrates are then pumped to a thickener where some water is removed from the slurry. After further dewatering, concentrates are deposited in a bin and put into haul trucks by front-end loader. Approximately 51,000 tons per year of concentrate would be trucked to the Noxon railroad siding via Forest Service Road No. 150 and U.S. 200. The ore processing plant would operate 7 days a week, 357 days a year for a total processing capacity of 3.6 million tons/year.

Tailings storage. The proposed tailings impoundment area is located approximately three miles southeast of Noxon, east of Montana U.S. 200, near the confluence of Rock Creek and the Clark Fork River. The majority of the impoundment would be located on private land in Section 28,

T26N, R32W, extending on to National Forest System lands to the east and north. The Cabinet Mountains are located immediately to the north, east, and southeast, with maximum elevations of about 7,500 feet. The impoundment area ranges in elevation from 2,360 to 2,700 feet. Over a 30-year production life, approximately 100 million tons of tailings would be stored in the proposed impoundment.

An initial starter dam would be constructed with nearby borrow materials and would provide tailings storage during initial operation stages. Due to the area's topographical features, two initial impoundments would be operated. Embankments would be incrementally raised to provide additional storage capacity, using the upstream construction method. With this method, the crest of the expanding embankment section is progressively shifted upstream of the original starter dam crest. As embankments are raised, the two impoundment areas would join, forming a single storage facility ultimately covering 377 acres. The embankment would need to be raised about 250 feet to a peak elevation of 2,685 feet to provide sufficient capacity to store tailings.

Water use and management. During full production, the mill would require 3,048 gallons per minute (gpm) of process water. This water may come from the following sources: mine adit water, fresh water wells, waste water from sewage treatment, plant site runoff, thickener overflow, and reclaimed water from the tailings impoundment. A well capable of supplying full make-up water requirements would be installed in Rock Creek alluvium.

ASARCO has estimated that up to 2,000 gpm of mine inflow water may be encountered. The water would be contained and channeled to two 100,000-gallon mine sumps for settling and storage. Water would be recycled for mining operation use, and any excess water would be used in the concentrating process, or discharged via percolation ponds, land irrigation, and tailings impoundment seepage.

A sewage treatment facility would be incorporated into the plant design. Effluent from the contact chamber would be directed to the tailings storage system, and sludge would be disposed at an approved off-site facility.

Roads. To reach the proposed plant site area, vehicles would leave U.S. 200 and travel on USFS Road 150 for about eight miles. A portion of this road is located in the proposed tailings impoundment area and would require rerouting. A new bridge over Rock Creek would be required at the junction of the new and existing roads.

For public safety and plant security, ASARCO proposes relocating Road No. 150 about 4,800 feet from the proposed plant site. These access roads would be upgraded and paved to handle the projected traffic load. Two additional roads would be required to access the mine portals and the surface conveyor transfer point. Main access road maintenance would be ASARCO's responsibility, unless additional use by the Forest Service or other interests warrants a cost share agreement. Maintenance responsibility would revert to the Forest Service upon mining activity completion.

Utilities. Electrical service to the plant site would be 230-kV, 3 phase, 60 cycle, provided via a new, overhead line from an existing substation near Noxon Rapids Dam. The line would be less than 10 miles long. An outdoor substation at the plant site would transform the 230-kV service to 4.16-kV for plant distribution, and 13.2-kV for mine distribution. Energy needs at the tailings impoundment would be met by a smaller substation, located 0.8 mile from U.S. 200, adjacent to the mine access road. Annual power consumption is estimated at 95 million kilowatt-hours, with a peak demand of 13,300 kilowatts.

Mine employment. The preproduction phase would entail access road construction; mine development; surface plant construction; plant access road renovation; tailings embankment construction; and installation of service facilities. This phase is

estimated to employ 34 workers the first quarter and 465 employees in the fifth quarter over a 36-month period. The vast majority of these positions would be temporary contract labor jobs.

Following the initial phase, the underground facilities, surface plant, and mine/mill complex would be brought to full production over a 6-month period. Personnel would increase accordingly from 305 in the first quarter of this second phase, to 355 in the third quarter, where permanent employment is projected to stabilize.

Road Closures

Forest standards (Kootenai National Forest, 1987, Appendix 8) for open road density in areas managed for grizzly bear habitat specify a maximum average density of 0.75 miles of open road per 640 acres. The KNF evaluates compliance with this standard for each timber compartment. Current open road density exceeds the standard. The KNF will permanently close 23.4 miles of National Forest System roads by September 1, 1992 to be in compliance with this standard (Table 2-12). The proposed KNF road closures are shown in Figure 2-27.

Table 2-12. Roads proposed for closure.

Road no.	Road name	Miles
2316	Upper Libby	1.3
2317	Lower Poorman	1.7
4725	North Fork of Miller Creek	3.7
4726	South Fork of Miller Creek	2.1
4777	Howard Creek	1.7
4778	Howard Creek	1.6
4783	Lower Cable Creek	1.1
4784	Upper Bear Creek	2.4
6210	Ramsey-Libby	2.0
6212	Little Cherry Loop	1.4
6212L	Little Cherry	0.6
6214	Cable-Poorman	3.4
	Spur to Ramsey Creek	0.4
Total		23.4

Source: Libby District, KNF. 1990.

Other Developments

In 1982, the KNF received an application from Great Northern Ski Corporation for a ski area development on Great Northern Mountain. The area would encompass about 1,400 acres of KNF lands on the northeast face of Great Northern Mountain. The proposal also included a high-density, mixed commercial/residential area. After receipt and review of the application, the KNF concluded that the development required an EIS, the costs for which would be borne by the developers. No further action has been taken on the application by either the developers or the KNF. Libby Ski Search has informally proposed to develop a ski area on Treasure Mountain. The proposal is not fully developed and the KNF has not received an application. These projects are not considered "reasonably foreseeable" within the context of NEPA and MEPA and were not considered in cumulative impact assessment.

No other large-scale industrial activities are reasonably foreseeable within the analysis area over the 16-year mine life.

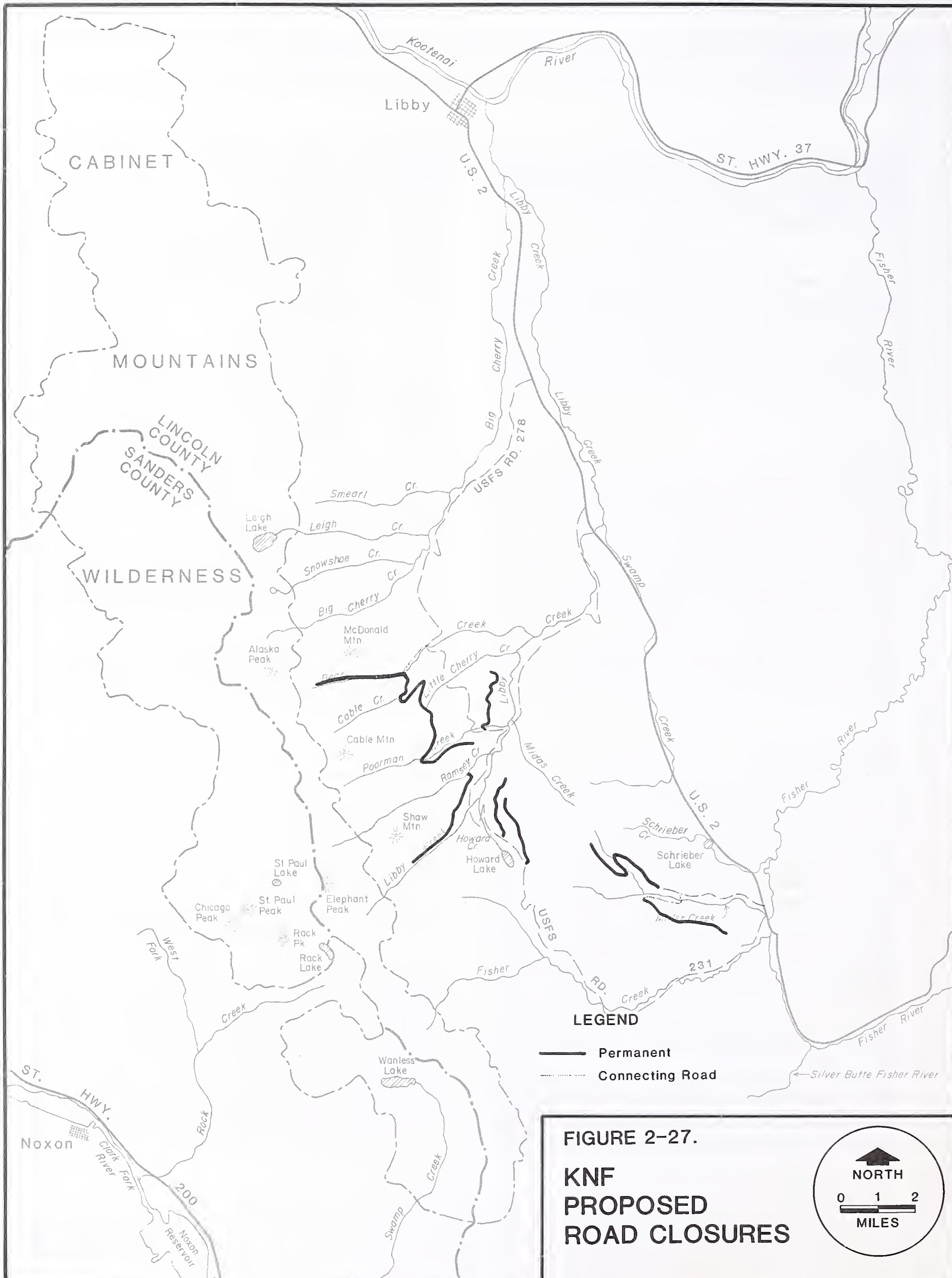


FIGURE 2-27.

KNF PROPOSED ROAD CLOSURES

3

THE AFFECTED ENVIRONMENT

NORANDA has conducted extensive studies to characterize the environmental resources of the proposed project area. Studies have been conducted in cooperation with the agencies by specialists in more than a dozen disciplines. (Study methods are described in Chapter 6 of this EIS.) Environmental monitoring is continuing and would be continued for the duration of the project.

The proposed project area comprises a 3,221-acre mine permit area and a 988-acre transmission line corridor. About 1,225 acres are proposed for surface disturbance in the project area. The project area is situated in the Kootenai National Forest 18 miles south of Libby in northwestern Montana. Elevation of the project area ranges from 2,800 feet along the Fisher River to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is largely influenced by elevation and topography. Two tributaries of the Kootenai River, Libby Creek and the Fisher River, provide surface water drainage.

Public lands are managed by the KNF under the multiple use policies of the KNF Forest Plan. Small areas of private land occur in the project area. Timber harvesting, recreation, and wildlife habitat are the predominant land uses.

This chapter is a synopsis of environmental baseline information compiled by Noranda in permit applications submitted for the project (Noranda Minerals Corp., 1989a and 1989c). Other sources of information also are cited. In the following sections, "project area" refers to an area surrounding all project components—mine, mill, tailings impoundment, adits, percolation ponds, access roads and transmission line corridor. Within the project area are the "mine area" and the "transmission line corridor area."

METEOROLOGY AND CLIMATE

The region has a "modified continental maritime" type of climate. The regional climate is influenced and modified by Pacific Ocean maritime air masses.

Summers are warm and dry and winters are cold. The Pacific Ocean influences development of coastal storms, which occasionally track across the state of Washington, east into northern Idaho and Montana. The relatively high mountain ranges to the west and north tend to attenuate these storms, so that most rain or snow occurs on the west or north side of the Cabinet Mountains, with drier conditions in the project area.

In winter, cold Canadian air masses can cause periods of extremely cold temperatures. Cold air movement into the region forms temperature inversions, which may trap pollutants near the land surface. More frequently, dry continental air masses from Canada or the east influence the region. In summer, these air masses create conditions of warm temperatures and low humidity.

Project Area Climate

Although similar to the regional climate, the climate of the project area is highly influenced by local terrain and elevation. The project area's mountainous terrain produces significant precipitation and temperature variations. Project area elevations range from 2,800 feet at Sedlak Park to almost 8,000 feet at Elephant Peak in the Cabinet Mountains. The town of Libby is about 2,000 feet above sea level. Additional details are described in the following sections.

Atmospheric stability. Atmospheric stability is a measure of small-scale air movement. Stability is an indicator of how readily air pollutants may be dispersed. Stability monitoring results, shown in Table 3-1, indicate that the more stable classes, D, E, and F, are predominant at the site.

Wind. Wind velocities vary according to terrain features, with higher wind speeds at ridge tops and lower wind speeds in protected valleys. The upper level winds (above 10,000 feet) comes from the northwest, and surface winds follow topographic relief (valley flow) in times of low weather activity. The wind speed minimum, maximum and frequency values for two monitoring locations are shown in Table 3-2. Over 50 percent of the winds at Ramsey Creek and nearly 90 percent of the winds at Little Cherry Creek are less than 3.5 mph. The average wind speed at Ramsey Creek for the monitoring year was 5 mph. The highest wind speed recorded was 28.4 mph at the Ramsey Creek site in the first quarter of the year. Wind speed averages 2.4 mph at the Little Cherry Creek site, which is lower than that reported at Libby (U.S. Dept. of Commerce, 1968) and the East Fork Rock Creek (TRC Environmental Consultants, Inc., 1987).

Figure 3-1 presents the wind rose (frequency

Table 3-1. Stability class distributions (%).

Stability class	Little Cherry Creek	Ramsey Creek
A	17.8	12.5
B	10.1	9.9
C	9.7	8.9
D	10.3	24.1
E	11.3	16.7
F	40.8	27.9

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 8 and 10.

Table 3-2. Wind speed distributions.

Wind speed (mph)	Little Cherry Creek	Ramsey Creek
	Frequency (%)	
0-3.5	87.09	57.23
3.6-6.90	11.40	21.67
7.0-11.5	1.48	14.70
11.6-18.4	0.02	5.77
18.5-24.2	0.02	0.52
>24.3	0.00	0.01
Average speed:	2.4 mph	5.0 mph
Maximum speed	19.7 mph	28.4 mph

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 9-10.

distribution of wind directions and speeds) for the Little Cherry Creek and Ramsey Creek monitoring locations. Predominant wind directions are from the southwest-to-southeast sectors. At Ramsey Creek, the measured predominant wind direction contrasts with the orientation of the creek drainage (southwest-to-northeast), and the tendency for upper level winds to be northwest. Libby's prevailing winds are east-to-southeast with an average annual speed of 6.0 mph (U.S. Dept. of Commerce, 1968).

Precipitation and evaporation. Annual precipitation in the project area, which is influenced primarily by the mountains, may vary from 10 to 100 inches. The annual precipitation measured at Little Cherry Creek was 9.56 inches (Table 3-3). This compares to average annual precipitation at Libby of 19.1 inches. Other area precipitation measurements indicate much

Table 3-3. Precipitation measured at Little Cherry Creek.

Time period	Precipitation (in.)
Quarter 3, 1988	1.00
Quarter 4, 1988	3.85
Quarter 1, 1989	2.48
Quarter 2, 1989	2.23
Period of Record	9.56

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 8 and 10.

higher amounts (up to 100 inches) are possible (Noranda Minerals Corp., 1989a). The amount of precipitation recorded was considered low and not used in designing tailings impoundment facilities.

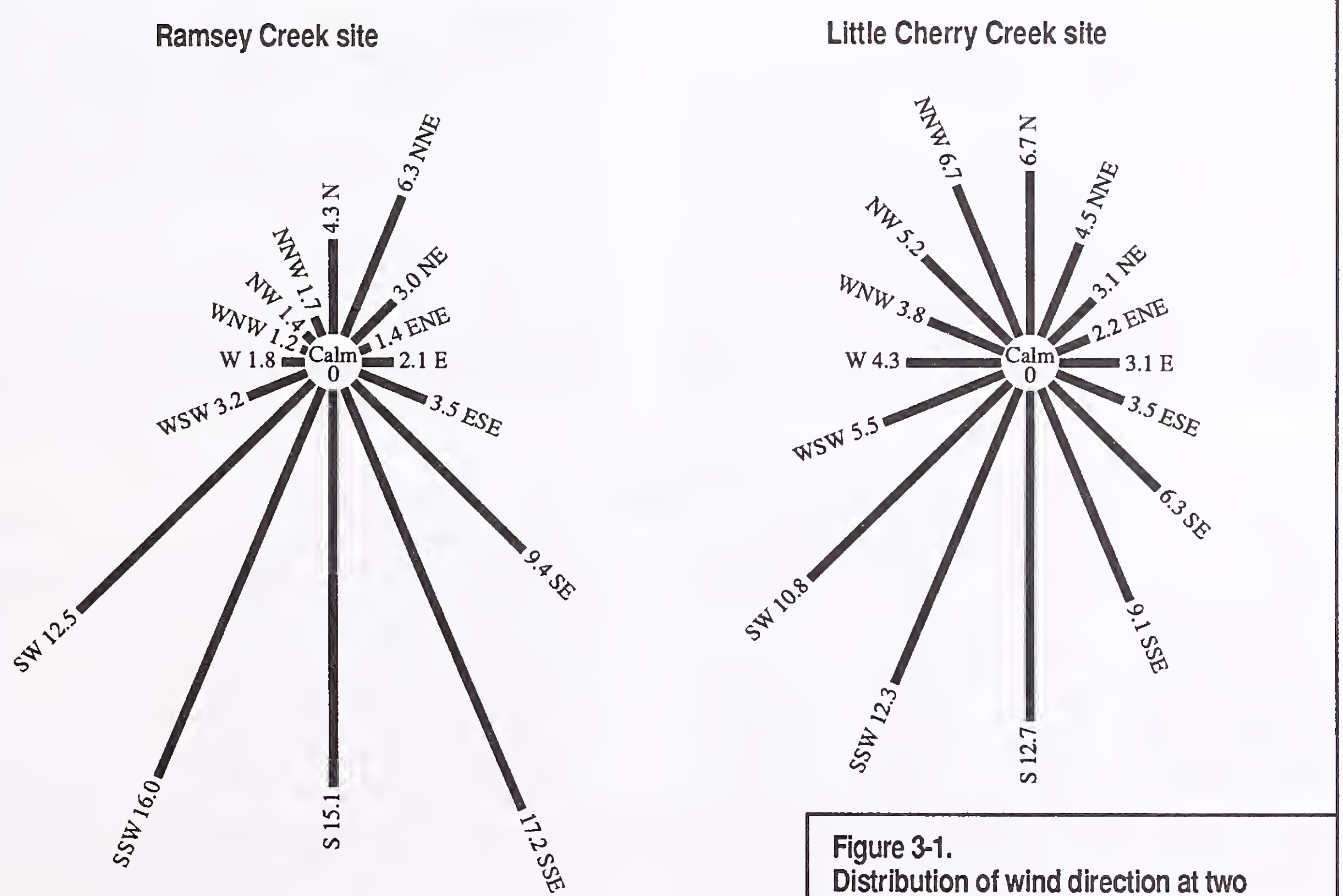


Figure 3-1.
Distribution of wind direction at two monitoring locations, in percent of time

Precipitation occurs as snow in winter with accumulations at the mine site totaling about 90 inches during mid-March (P. Farnes, SCS Water Supply Specialist, pers. comm. w/ T. Ring, DNRC, January 2, 1989). Rain-on-snow may also occur in mid-winter and early spring which can result in significant runoff events.

The average relative humidity for the monitoring year is 61 percent. Reported averages for northwestern Montana range from 65 to 75 percent. Annual evaporation is about 35 inches.

Temperature. Temperatures in the project area are cold in the winter and mild in the summer. The annual average temperature is about 5°C with a range between -32.3°C and 34.8°C (Table 3-4).

AIR QUALITY

Airborne Particulates

The concentrations of total suspended particulates (TSP) and particulate matter smaller than 10 micrometers (µm) (PM-10) at the monitoring locations are in compliance with annual state and federal air quality standards. The annual arithmetic and 24-hour maximum PM-10 standards are 50 micrograms per cubic meter (µg/m³) and 150 µg/m³, respectively, and the annual geometric and 24-hour maximum TSP standards are 75 µg/m³ and 260 µg/m³, respectively. Air monitoring information is summarized in Table 3-5.

Table 3-5. Particulate concentrations measured at Little Cherry Creek and Ramsey Creek

Parameter	Little Cherry Creek (µg/m³)	Ramsey Creek #1 (µg/m³)	Ramsey Creek #2 (µg/m³)
PM-10			
Average	14	12	13
24-hour maximum	189	157	153
TSP			
Average	33	not collected	
24-hour maximum	267	not collected	

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 13-15.

The maximum measured PM-10 and TSP values each exceeded their respective standards on one occasion in the fall of 1988. These values may represent an anomalous event, such as numerous forest fires in the region, and do not represent normal background conditions (Woodward-Clyde Consultants, Inc., 1989a).

The Montana Department of Health and Environmental Sciences operates a PM-10 monitoring site at the Lincoln County Courthouse near the center of Libby. In 1988, PM-10 levels in Libby averaged 64 µg/m³

Table 3-4. Temperatures measured at Little Cherry Creek and Ramsey Creek (in °C).

Time period	Little Cherry Creek Min.†	Little Cherry Creek Max.	Little Cherry Creek Average	Ramsey Creek Min.	Ramsey Creek Max.	Ramsey Creek Average
3rd Quarter, 1988	-2.1	32.8	14.8	-5.0	34.8	13.1
4th Quarter, 1988	-18.5	17.2	0.2	-23.3	27.0	1.0
1st Quarter, 1989	-31.3	12.0	-4.6	-32.3	14.5	-4.0
2nd Quarter, 1989	-13.5	26.7	6.7	-8.3	29.6	8.5
Period of record	-31.3	32.8	4.3	-32.36	34.8	4.7

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. 9-10.
†Minimum and maximum values are hourly averages.

and exceeded the 24-hour standard for fifteen days. The maximum 24-hour concentration was 256 $\mu g/m^3$. Airborne particulate levels in Libby and nearby residential areas are substantially above the health-based PM-10 standards.

The high PM-10 levels and associated health risks require the State of Montana to develop an emission control plan to bring the area into compliance. The plan will require reductions in emissions from existing sources and severely limit the type of new air pollution sources which can be permitted in the area.

Much of the technical studies necessary to develop the control plan is already complete. These studies indicate that the primary emission sources contributing to noncompliance are residential wood burning and street dust caused by vehicle traffic. Other sources include automobile exhaust, the Champion International facilities, and forestry slash burning.

Trace metal concentrations in suspended particulates are low. None of the monthly values exceed any federal ambient standard or Montana guideline concentration.

Gaseous Pollutants

No measurements of other criteria pollutants, such as carbon monoxide, sulfur dioxide, ozone, nitrogen oxides, or hydrocarbons were made in the project area. Given the remoteness of the project area and the lack of significant air pollution sources, low background levels are assumed.

Visibility

No visibility measurements have been made at the plant site. It may be assumed that visibility is usually high, except during times of forest fires, controlled burning, or significant truck travel on nearby roads. The nearby Cabinet Mountains Wilderness is classified as a Class I Prevention of Significant Deterioration (PSD) area. This designation is for those areas of the country (such as National Parks and wilderness areas) where little or no air quality degradation is allowed. In addition to strict ambient air quality standards, visibility protection is also required. PSD issues are discussed in greater detail in the following section.

PSD Designation and Issues

Under the Prevention of Significant Deterioration regulations, the proposed project area is designated as Class II and the Cabinet Mountains Wilderness is Class I. The following is a brief description of PSD regulations.

The PSD program was originally enacted by the U.S. Congress in 1977 and the authority to implement the provisions was subsequently delegated to the State of Montana by the EPA. The goals of the program are—

- to protect public health including the prevention of significant deterioration in areas where ambient air quality standards are being achieved;
- to emphasize the protection and quality in National Parks, wilderness areas, and similar areas of special concern; and
- to ensure that economic growth in clean areas occurs only after careful deliberation by state agencies and local communities.

Unlike the enforcement of the National Ambient Air Quality Standards, the PSD program is implemented primarily through the use of pollutant increments and area classifications. An increment is the maximum increase (above a baseline concentration) in the ambient concentration of a pollutant that would be allowed in an area. Increment systems have been in place for particulate matter and SO_2 for a number of years and have been recently adopted for nitrogen oxides. The area classification scheme establishes three classes of geographic areas and applies more stringent increments to those areas recognized as having higher air quality values. Class I areas are accorded the highest level of protection by allowing the smallest incremental pollutant increase.

The proposed project does not fall under PSD requirements because the source is under the

regulatory 250 ton/year emission threshold which characterizes a "major stationary source." PSD requirements, however, will be discussed in the impact analysis of Chapter 4 to ensure that all potential impacts are addressed.

GEOLOGY

The project area lies within the northern Rocky Mountain physiographic province and is situated on the eastern flank of the Cabinet Mountains in northwestern Montana. The project area is bordered on the east by the Fisher River valley, the lowest topographic feature in the project area. The Sedlak Park substation site is located in the Fisher River valley at approximately 2,800 feet elevation. To the west, the Cabinet Mountains rise to an elevation of 7,938 feet at Elephant Peak. Elephant Peak is the highest peak in the project area and is located on the divide separating the Rock Creek and Libby Creek drainages.

Steep-sided mountain valleys are found throughout the project area. Steep cirques are found at the heads of most valleys in the western portion of the project area. The mountain sides are sparsely to heavily forested; timberline occurs at about 7,000 feet.

Regional Geology

A thick series of metasedimentary rocks of late Precambrian age known as the Belt Supergroup underlies most of northwestern Montana (Johns, 1970). These rocks were originally deposited as unconsolidated sand, silt, and clay, and as carbonate. Subsequent regional low-grade metamorphism altered the sediments to form quartzite, siltite and argillite.

At least two ages of igneous rocks intrude the Belt Supergroup. Rocks high in iron and magnesium of Precambrian age intrude the Wallace, Burke and Prichard formations (Wells et al., 1981). Granodiorite and quartz monzonite plutons (igneous rock types which have intruded beneath the earth's surface) of Cretaceous age occur in the Dry Creek area in the northern part of the Cabinet Mountains Wilderness. Some metamorphism has occurred at the contact between these plutons and the metasedimentary rocks.

The region was significantly folded and faulted during mountain building of late Cretaceous to late Tertiary time. Block faulting occurred in the late Cenozoic Era. Folding consists of large, tight to open, symmetrical and asymmetrical folds, primarily trending northwest or north (Johns, 1970). Major faulting postdates folding and is oriented northwest to north, paralleling the fold axes.

Structural anticlines are present in the Cabinet Mountain Range near the north and south ends. The southern anticline, called the Snowshoe Anticline, is cut by the Snowshoe fault and its branches. The crest of the anticline is parallel to the Rock Lake Fault for more than six miles (Wells et al., 1981).

Extensive glaciation and erosion followed the uplift of the Cabinet Mountains. Northwestern Montana, including the project area, has been glaciated several times. During the most recent glaciation, the continental ice sheet advanced into northwestern Montana and Idaho, blocking the Kootenai River valley and the Clark Fork river valley (Johns, 1970). Geologic evidence indicates glacial lakes deposited fine-grained silts and clays along the Fisher River, West Fisher Creek, and the lower portions of Miller Creek. Glaciofluvial deposits also can be found in terraces along some drainages within the project area. Glaciation in the project area is evident by truncated ridges between the project area stream valleys.

Geology of the Mine Area

The ore deposit proposed for mining is one of several stratabound copper deposits occurring in a belt about 120 miles long and 40 miles wide, extending from British Columbia to the Coeur d'Alene mining district in Idaho (Banister et al., 1981). The mine area stratigraphy consists of metasedimentary deposits of Precambrian age (Belt Supergroup) and unconsolidated deposits along valley bottoms. Bedrock formations include (from oldest to youngest) the Prichard, Burke, Revett, St. Regis, and Wallace

formations (Table 3-6). The Burke, Revett, and St. Regis formations comprise the Ravalli Group. Narrow, unconsolidated deposits consisting of glacial gravels, and modern alluvium and colluvium are found along upper Libby Creek and Ramsey Creek valleys.

The area geology is shown in the mine area geologic map and cross section (Figure 3-2). The structure containing the ore body is a breached, overturned syncline, which plunges to the north and is overturned to the east (Figure 3-2). The overturned syncline is bounded on the west by the Rock Lake Fault and on the east by the Libby Lake Fault. The fold axis of the syncline parallels the Rock Lake Fault. The Rock Lake Fault is over 30 miles long. At St. Paul Pass, the fault trends N40°W and dips steeply to the east. Displacement is reported to be 2,500 feet near St. Paul Lake (Banister et al., 1981).

The ore body occurs in the Revett Formation, which is subdivided into the upper, middle and lower Revett, based upon the amount of quartzite, silty-quartzite, and siltite. The majority of the silver/copper mineralization occurs in the upper portion of the lower Revett. The mineralized zone lies on the lower limb of the overturned syncline, and is truncated on the west by the Rock Lake Fault (Figure 3-2). The mineralization is predominantly copper and copper-iron sulfides, including bornite, chalcocite, and chalcopyrite. Silver occurs as native silver. Lead sulfides (galena) and iron sulfides (pyrite and pyrrhotite) occur as a halo around the ore zone, but do not occur in any significant quantities within the zone.

Noranda has identified two distinct subparallel ore zones, the B-1 (upper) and B (lower), averaging 30 feet and 34 feet, respectively. These ore zones average 2.1 ounces per ton of silver and 0.78 percent (15 pounds per ton) copper (Noranda Minerals Corp., 1989a). The highest average grades encountered during drilling are 5.93 ounces per ton of silver and 1.13 percent copper. Current ore reserves are estimated at 140 million tons.

The silver/copper ore zones are separated by a low-grade lead zone (the barren zone) of disseminated and vein-related galena. The barren zone varies in thickness from more than 200 feet toward the west to 18 feet in the eastern portions of the mine area. The barren zone may be absent to the northeast.

Geology of the Tailings Impoundment Area

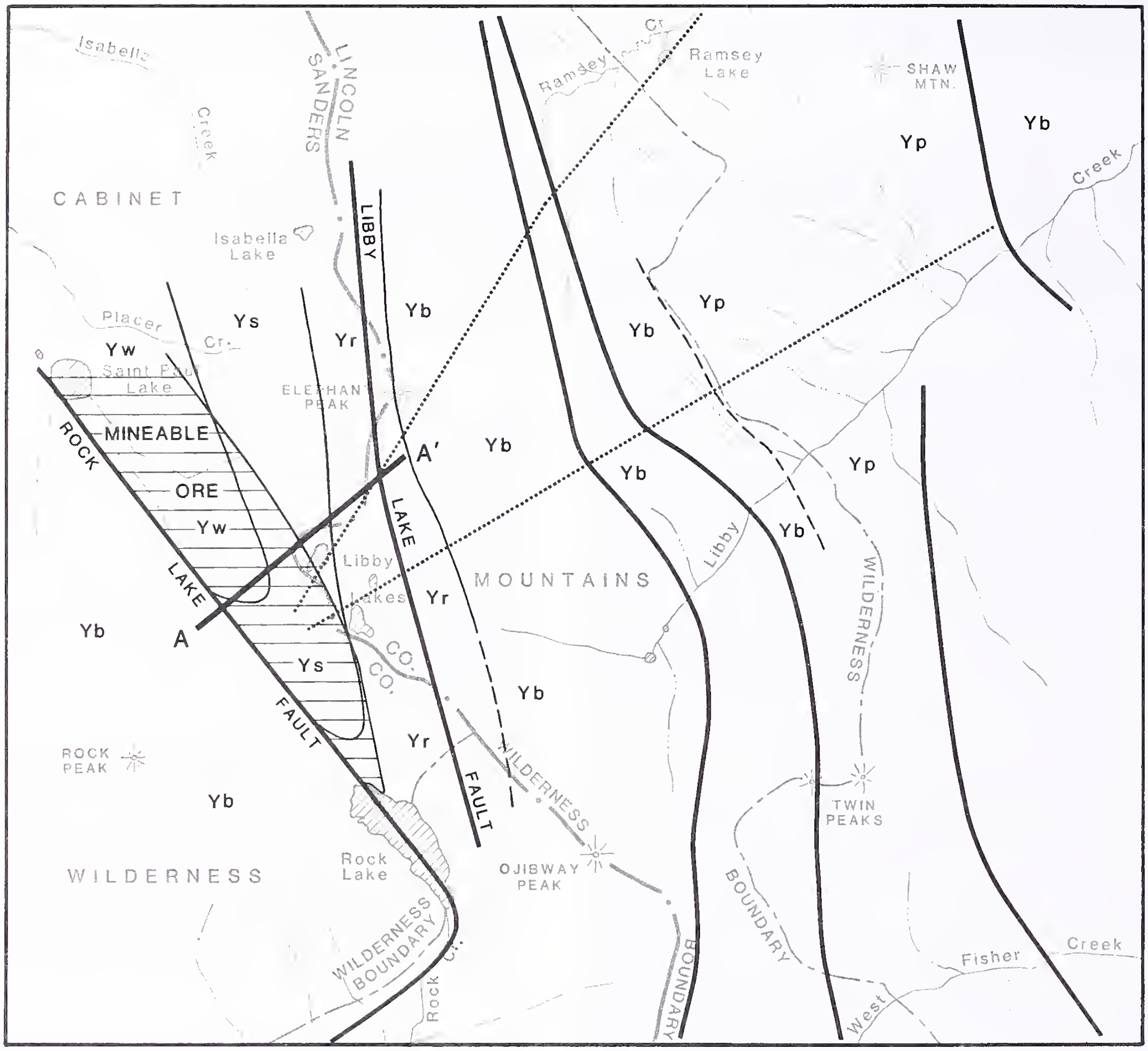
The geology of proposed tailings impoundment site consists of recent alluvium and colluvium, and Pleistocene lacustrine and glaciofluvial deposits overlying Precambrian bedrock (Figure 3-3). Based on weathered bedrock outcrops in this area, bedrock is identified as the Wallace Formation. The Wallace formation is overlain by as much as 300 feet of unconsolidated deposits.

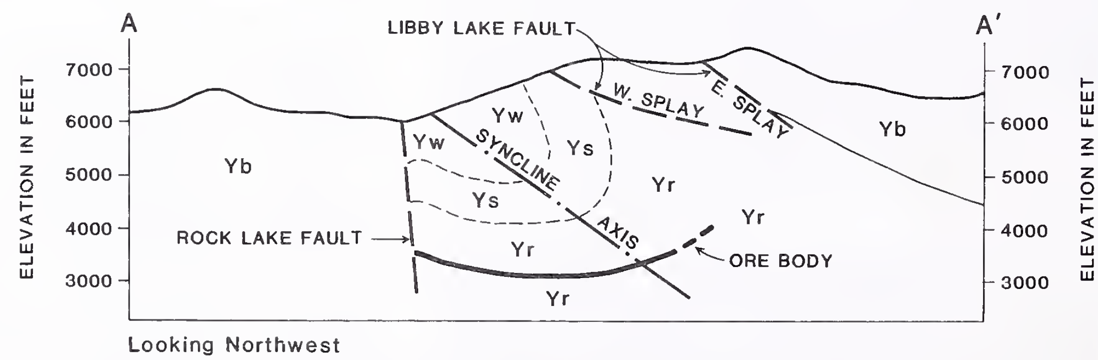
The glaciolacustrine deposits (lake bed deposits) resulted from glacial damming of the Libby Creek drainage. Lake bed deposits of silts and fine sand cover eastern portions of the area (Figure 3-3). Glaciofluvial deposits are intermixed silt, sand and gravel materials deposited by glacial meltwater streams. These unconsolidated deposits form an

Table 3-6. Bedrock stratigraphy of the mine area.

Formation name	Lithology description	Thickness (ft.)
Wallace	Grayish-green, calcareous argillite and siltite, with limestone and dolomite	10,000
St. Regis	Purplish-grey and greenish-gray argillite and siltite	500
Revett	White quartzite and gray siltite; contains silver/copper mineralization	2,500
Burke	Light-gray siltite	4,800
Prichard	Black and white laminated argillite and siltite	9,000

Sources: Noranda Minerals Corp., 1989a; Wells et al., 1981; and Johns, 1970.





CROSS SECTION A-A'

LEGEND

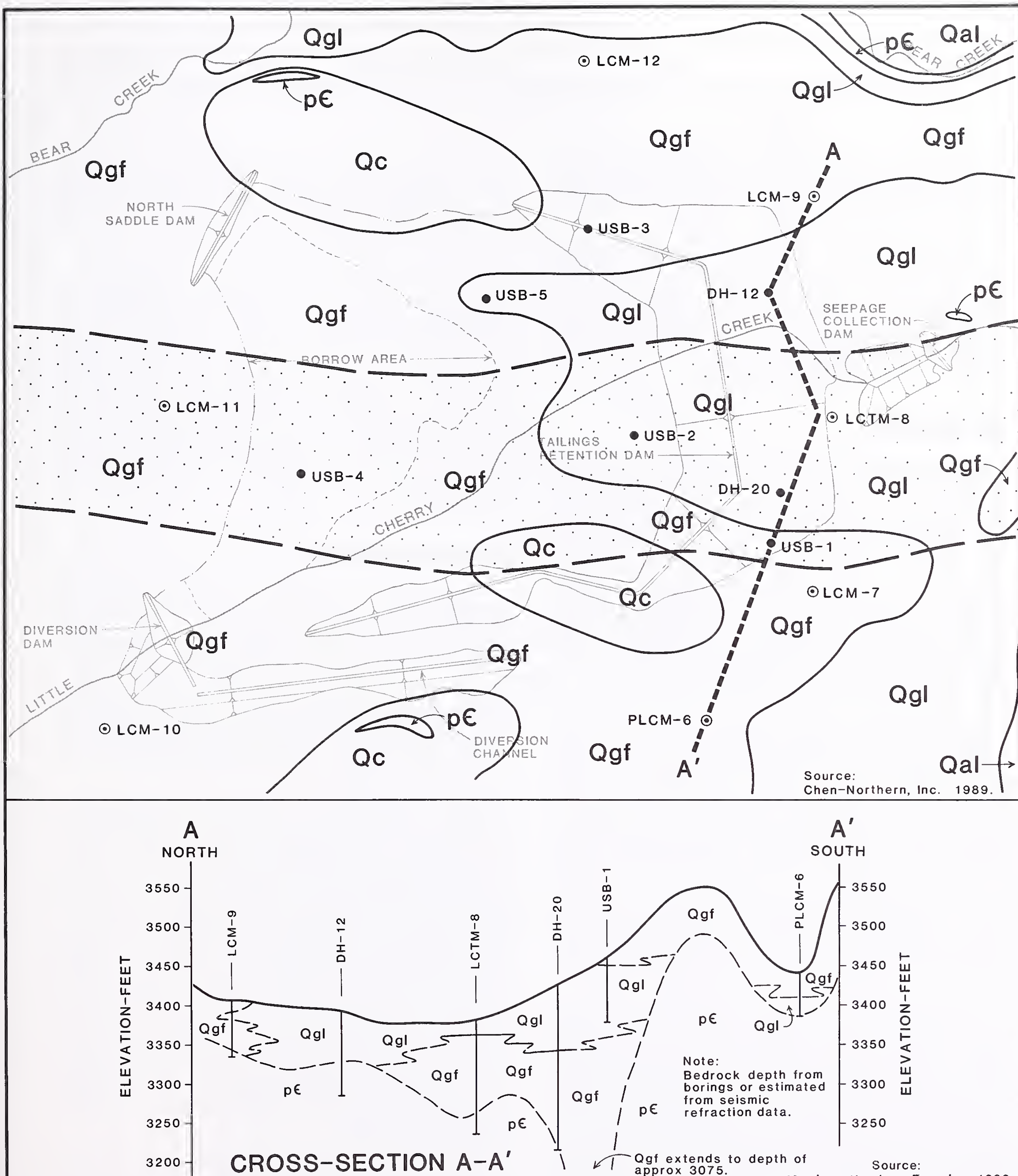
Yw	Wallace Formation
Ys	St. Regis Formation
Yr	Revett Formation
Yb	Burke Formation
Yp	Prichard Formation
	Fault
	Contact (Dashed where inferred)
A—A'	Cross Section A-A'
	Mineable Ore
	Adit

Source: Noranda Minerals Corp. 1989a.

FIGURE 3-2.

GEOLOGIC MAP AND CROSS SECTION - MONTANORE PROJECT ORE BODY

NORTH
1000 0 2000
FEET



LEGEND

Qal	Alluvium
Qc	Colluvium
Qgl	Glaciolacustrine Deposits
Qgf	Glaciofluvial Deposits
pЄ	Precambrian Bedrock

- Approximate Location of Buried Channel
- Boring
- Monitoring Well
- Spring

NORTH

0 400 800

FEET

FIGURE 3-3.

GEOLOGIC MAP AND CROSS SECTION - TAILINGS IMPOUNDMENT AREA

apron along the mountain front. The glaciolacustrine and glaciofluvial deposits interfinger and overlap, and are not readily separated.

A buried, pre-glacial valley occurs in the proposed impoundment site (Figure 3-3). The channel underlies lacustrine deposits and is filled with over 275 feet of interbedded, poor to moderately-sorted, variably textured, stream-laid deposits. The buried valley has no surface expression.

Geologic Hazards

Potential geologic constraints in the project area were identified as part of the geological baseline studies. No landslides or unstable slopes were identified near the Ramsey Creek plant site, the Libby Creek portal site, or the tailings impoundment site. Slope failures, however, were noted where roads undercut hillsides in the North Fork of Miller Creek, and several slumps are occurring on the cut slopes. Fine-grained soils derived from lacustrine silts and clays also are susceptible to slope failures if undercut.

Several avalanche chutes occur in both upper Libby Creek and Ramsey Creek valleys (Figure 3-4). Over twenty snow chutes ranging in length from 1,000 feet to more than 5,000 feet were identified. Because of the high elevation of the chute tops and the narrow widths of the valleys below, avalanches can cross valleys and move up the opposite side. Similar hazards in the form of wet snow slide paths also occur in upper Libby Creek and Ramsey Creek valleys. These paths are typically very narrow and difficult to detect from aerial photographs.

The project area lies near the northern end of the Intermountain Seismic Belt, a north-south oriented zone of seismic activity which includes the Wasatch Mountain Front in Utah, the Teton-Yellowstone area in Wyoming, and parts of the Northern Rockies in western Montana. There is no record of moderate-to-large earthquakes locally. The two largest earthquakes, the Hebgen Lake (Montana) earthquake in 1959 and the Borah Peak (Idaho) earthquake in 1983, were both about 300 miles from the project area. They caused no significant effects on the Libby area. Smaller earthquakes have occurred in the Idaho panhandle in the vicinity of Lake Pend d'Oreille, and between Libby and Kalispell (Table 3-7).

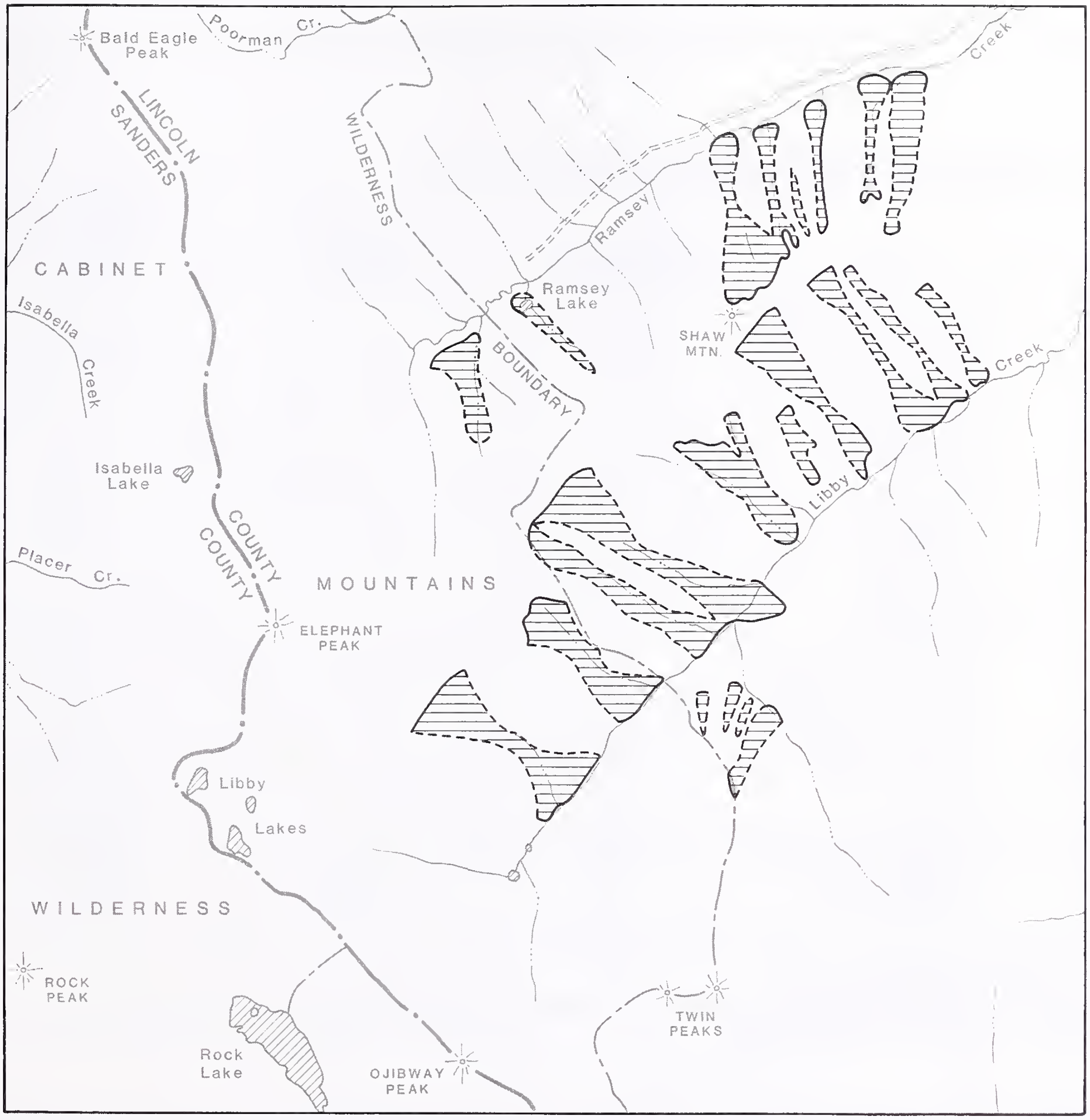
The frequency of smaller events and the presence of long faults of undetermined seismic activity indicate that a large earthquake is possible in the project area. The Maximum Credible Earthquake was estimated for several potentially active earthquake sources—the Bull Lake or Rainey Creek faults, the Flathead Lake Seismic Zone, and a random local earthquake. The estimated Maximum Credible Earthquake from these sources ranges from 6.5 to 7.3 in magnitude on the Richter scale.

Other Geologic Resources

The project area is located in a region rich in mineralization. Historically, silver, lead, zinc, and gold have been produced from numerous mines and placer operations. Two abandoned prospects occur above the Montanore Project ore body near St. Paul Pass. Other mining prospects are known near the head of Miller Creek. More recently, several significant copper-silver deposits have been discovered.

Mining activity began in the project area around 1882 when placer gold was mined on Libby Creek near the confluence with Poorman Creek (Johns, 1970). Placer mining occurred throughout the Libby Creek watershed and included operations in Poorman Creek, Ramsey Creek, upper Libby Creek, and near the confluence of Little Cherry Creek and Libby Creek. Most placer mining took place during the 30 years following initial discovery. Some placer mining has occurred intermittently since and continues, although it is now primarily recreational. A recreational gold panning area has been developed by KNF one mile north of Howard Lake on Libby and Howard creeks.

At higher elevations in the Cabinet Mountain Range, numerous operations mined the mineralized zones associated with the Snowshoe and Rock Lake faults. Lead, zinc, silver, copper and some gold



Source: Morrison-Knudsen Engineers, Inc. 1989b; IMS Inc. 1990

LEGEND

Avalanche Chute

FIGURE 3-4.

AVALANCHE CHUTES IN LIBBY AND RAMSEY CREEK DRAINAGES

NORTH

1000 0 2000

FEET

Table 3-7. Significant earthquakes in the region.

Date	Location	Magnitude (Richter scale)	Maximum intensity§	Distance from project area (miles)
2-25-71	S.E. of Libby, MT	—	IV	14
6-26-64	Marion, MT	4.7	IV	21
3-12-18	Lake Pend d'Oreille, ID	—	IV	27
4-15-52	Whitepine, MT	—	IV	30
8-16-60	Sandpoint, ID	—	IV	47
7-10-30	Missoula, MT	—	V	48
12-19-57	Wallace, ID	5.0	VI	48
11-28-26	Wallace, ID	—	V	48
5-9-44	Wallace, ID	—	IV	48
6-8-54	Wallace, ID	—	V	50
9-23-61	Wallace, ID	—	IV	51
11-01-42	WA/ID border	—	VI	52
9-23-45	Flathead Lake, MT	5.5	VII	65
2-4-75	Creston/Kalispell, MT‡	4.6	VI	66
3-31-52	Big Fork, MT	5.5	VII	70
7-31-69 to 10-30-70	Canada (9 events)	5.0 to 5.3	VI	116 to 128
12-20-72	Canada	5.1	VI	116
7-16-36	Milton-Freewater, OR	5.75	VII	205
8-17-59	Hebgen Lake, MT	7.5	X, V†	293
10-28-83	Borah Peak, ID	7.3	IX, V†	310

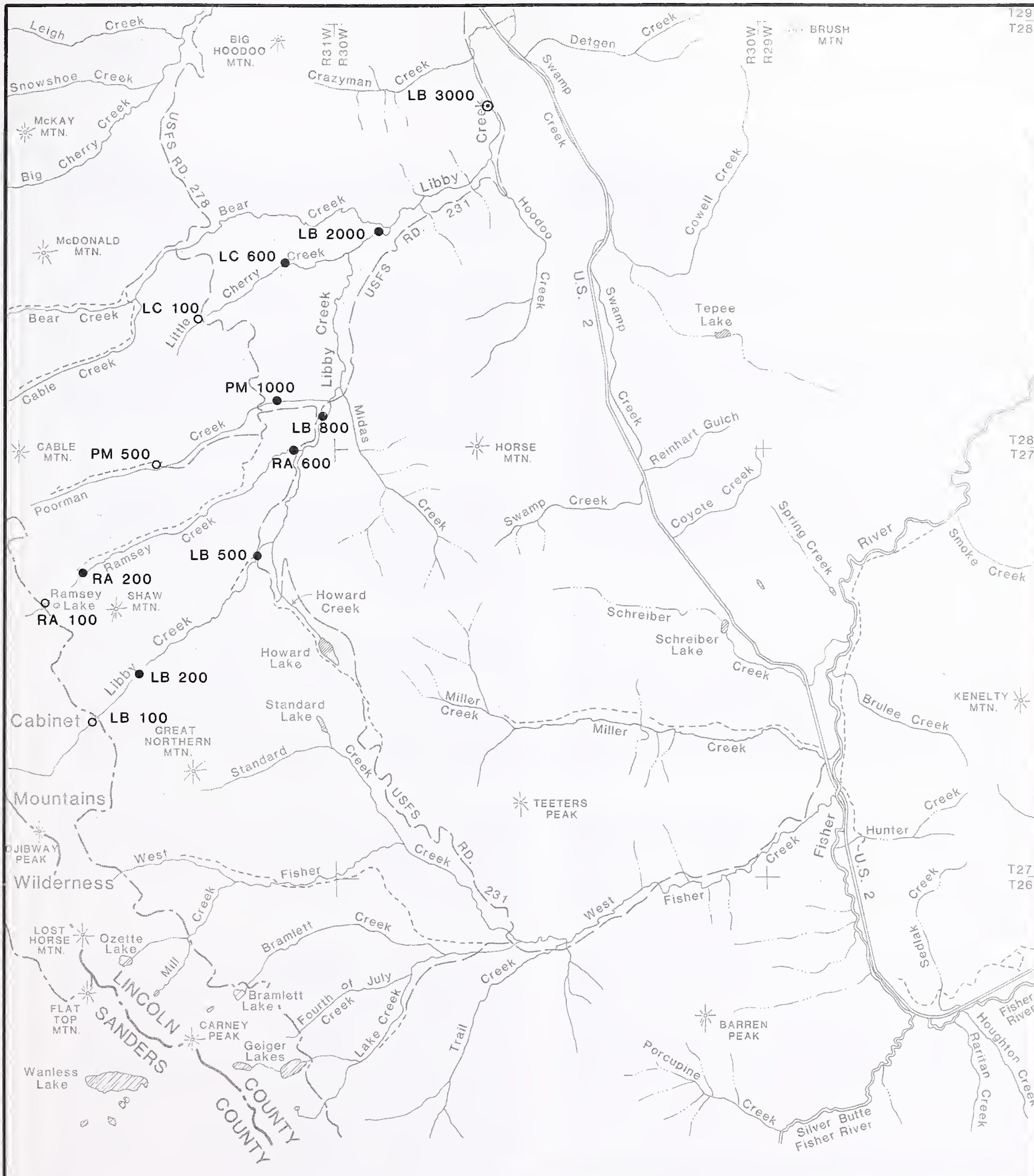
Source: Noranda Minerals Corp. 1989a. V. 1, p. II-86.
§Epicentral Modified Mercalli Intensity
‡Representative event; numerous other earthquakes with magnitudes less than 5 have occurred near Flathead Lake.
†Reported local intensity at Libby, Montana

mineralization occurs at rock outcrops along the Snowshoe Fault. The majority of this mining was along the fault zone between Flower and Lake creeks, where the Snowshoe Mine was the largest producer. Several historic mining operations were also associated with the Rock Lake Fault, where gold was found in association with sulfide mineralization. The Heidelberg Mine, which began operations in the 1920s, has the only production recorded from this fault zone (Banister et al., 1981).

Stratabound copper deposits are widespread in the Precambrian Belt Supergroup rocks, with the most significant deposits occurring in the Revett Formation quartzites. ASARCO's existing Troy mine is located in this type of mineral deposit. The proposed Montanore Project and ASARCO's proposed Rock Creek Project would also mine ore from this type of deposit.

HYDROLOGY

Mining would occur beneath the divide separating the Rock Creek and Libby Creek drainages. The mine area is drained on the east by Libby Creek and its tributaries—Ramsey Creek, Poorman Creek, and Little Cherry Creek (Figure 3-5). Libby Creek flows northward from the project area about 28 miles to its



Source: Noranda Minerals Corp. 1989a.

LEGEND

Surface Water Sampling Sites

○ Staff/Crest Gages

● No Gages

⊙ Continuous Recorder

NORTH

0 1 2

MILES

FIGURE 3-5.

SURFACE WATER SYSTEM OF THE PROJECT AREA

confluence with the Kootenai River at the town of Libby. Rock Creek flows southwest into the Clark Fork River downstream of Noxon Reservoir.

The transmission line corridor area is drained by tributaries of the Kootenai River—the Fisher River, Miller Creek, West Fisher Creek, Brulee Creek, Schrieber Creek, Swamp Creek, Fourth of July Creek, Ramsey Creek, Libby Creek, Trail Creek, and Standard Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the project area (Figure 3-5). In addition, several lakes and swampy areas also can be found in the project area. One-hundred-year floodplains have been designated along the Fisher River, Miller Creek, North Fork of Miller Creek, Ramsey Creek, and Libby Creek.

Surface Water

Snowmelt is the main source of surface water. High surface water flows typically occur during spring snowmelt, and during winter months when warm conditions combined with precipitation produce both snowmelt and runoff. Surface water conditions of mine area streams are described in the following sections.

Libby Creek. Libby Creek is a perennial stream with headwaters in a steep glacial cirque. The upper reaches of Libby Creek are intermittent and are restricted to a narrow canyon channel flowing across bedrock or coarse valley-fill and glacial deposits.

The Libby Creek valley widens downstream where more erodible alluvial, lacustrine, and glaciofluvial deposits are encountered. In these lower reaches, Libby Creek is perennial with flow sustained by ground water discharge. Libby Creek is the only stream in the mine area that has a significant flood plain.

Measured flow in Libby Creek ranges from 1.1 to 50.7 cubic feet per second (cfs) at the uppermost station above the proposed mine portals, and from 10.6 to 319.2 cfs at the most downstream station (Table 3-8). Peak runoff in early May, however, was not measured at the most downstream station. Estimated flood flow in the mine area ranges from about 950 to 2,500 cfs for a 100-year event.

Ramsey Creek. Ramsey Creek drains 6.5 square miles of watershed as it flows 5.3 miles to Libby Creek. The upper watershed is poorly drained and contains both a marshy area and a small lake (Ramsey Lake). Water in the marsh flows through a series of ponds and meanders through grassy, wet meadows. Downstream of the meadows, the channel becomes similar to Libby Creek.

Ramsey Creek is a perennial stream with heavily forested banks having an average streamflow of about 23 cfs (Table 3-8). The estimated 100-year flood ranges from 325 cfs to about 1,200 cfs near the proposed plant site.

Poorman Creek. Poorman Creek is a small, perennial stream located south of the tailings impoundment area. It has a drainage area of about 6.1 square miles and flows about 5.3 miles from its headwaters to its confluence with Libby Creek. Poorman Creek flows in a narrow, straight channel with heavily forested banks and a boulder, cobble, and gravel bed.

Streamflow in Poorman Creek ranges seasonally from 0.5 to 55 cfs (Table 3-8). Streamflow is relatively constant both upstream and downstream. The estimated 100-year flood ranges from about 400 to 1,300 cfs.

Little Cherry Creek. Little Cherry Creek is a perennial stream originating on the lower slopes of the Cabinet Mountains. It drains approximately 1.9 square miles, and flows 2.8 miles to its confluence with Libby Creek. Streambed material ranges from boulders to sand and silt. The upper portion of the watershed is forested and the lower portion has been logged. In logged areas, stream banks are collapsed, and small shrubs and forbs have become established.

Streamflow during baseline monitoring ranged seasonally from 0.1 to 6.7 cfs at the upstream station, and from 0.2 to 13.2 cfs at the downstream station in the tailings impoundment area (Table 3-8).

Streamflows are generally low (less than 3.0 cfs), and remain fairly constant between the upstream and downstream stations. Estimated flood flows in Little Cherry Creek range from 78 cfs to over 1,000 cfs for the 100-year event.

Bear Creek. Bear Creek is the largest tributary of Libby Creek in the project area, draining a 15-square mile area. Originating in a glacial basin at an elevation of 4,600 feet, Bear Creek flows 8.5 miles, converging with Libby Creek at an elevation of 3,050 feet. Most of the stream bed is heavily forest. The streambed material is primarily cobbles and gravels.

Streamflow measured at the one monitoring station in Bear Creek ranged from 1.8 cfs during the early fall (September) to a high of 98.1 cfs during the spring runoff in May. Estimated 100- year flood flows in Bear Creek range from 622 cfs to over 1,900 cfs.

Mountain lakes. Several alpine lakes occur in the project area (Figure 3-6). Many of these lakes are located in glacial cirques that act as collection basins for runoff and snowmelt. Rock Lake and St. Paul Lake are located along the Rock Lake Fault. Rock Lake is the headwaters source for East Fork of Rock Creek.

St. Paul Lake is the headwaters source for the East Fork of Bull River. Runoff from a small headwaters watershed (1.5 square miles) flows into St. Paul Lake. The lake is dammed by glacial morainal material, and outflow from the lake is through morainal gravels to a small pond located a few hundred feet downstream. Discharges from the pond flow to an unnamed tributary to the East Fork of Bull River. Other lakes, such as Libby Lakes and Isabella Lake, are smaller, and lie within closed depressions along the crest of the Cabinet Mountains.

Table 3-8. Measured flow (April, 1988 to April, 1989) and flood flow estimates in Libby Creek (in cfs).

Drainage	Station†	Stream discharge			Peak flood estimates		
		Mean	Minimum	Maximum	25 Year	50 Year	100 Year
Libby Creek	LB-100	27.7	1.1	50.7	—	—	—
	LB-200	34.6	2.1	73.6	312-439	355-772	416-1,325
	LB-500	31.1	1.0	84.4	—	—	—
	LB-800	59.6	2.9	173.8	740-1,060	827-1,653	947-2,517
	LB-2000	98.1	5.8	204.0	—	—	—
	LB-3000	127.3	10.6	319.2§	1,487-2,167	1,637-3,571	1,840-5,692
Ramsey Creek	RA-100	22.0	0.9	60.9	—	—	—
	RA-200	23.8	1.1	62.8	240-309	275-607	325-1,163
	RA-600	22.7	1.4	66.0	—	—	—
Poorman Creek	PM-500	14.0	0.5	53.0	—	—	—
	PM-1000	17.0	0.7	54.8	324-444	368-778	431-1,331
Little Cherry Creek	LC-100	1.5	0.1	6.7	—	—	—
	LC-600	2.4	0.2	13.2	53-234	64-502	78-1,049
Bear Creek	BC-100	43.8	1.8	98.1	476-859	538-1,319	622-1,918

Source: Chen-Northern, Inc. 1989. pp. 3-7 and 3-11.
†See Figure 3-5 for station locations.
§High flow not measured due to high water conditions.
— = flood flows not estimated

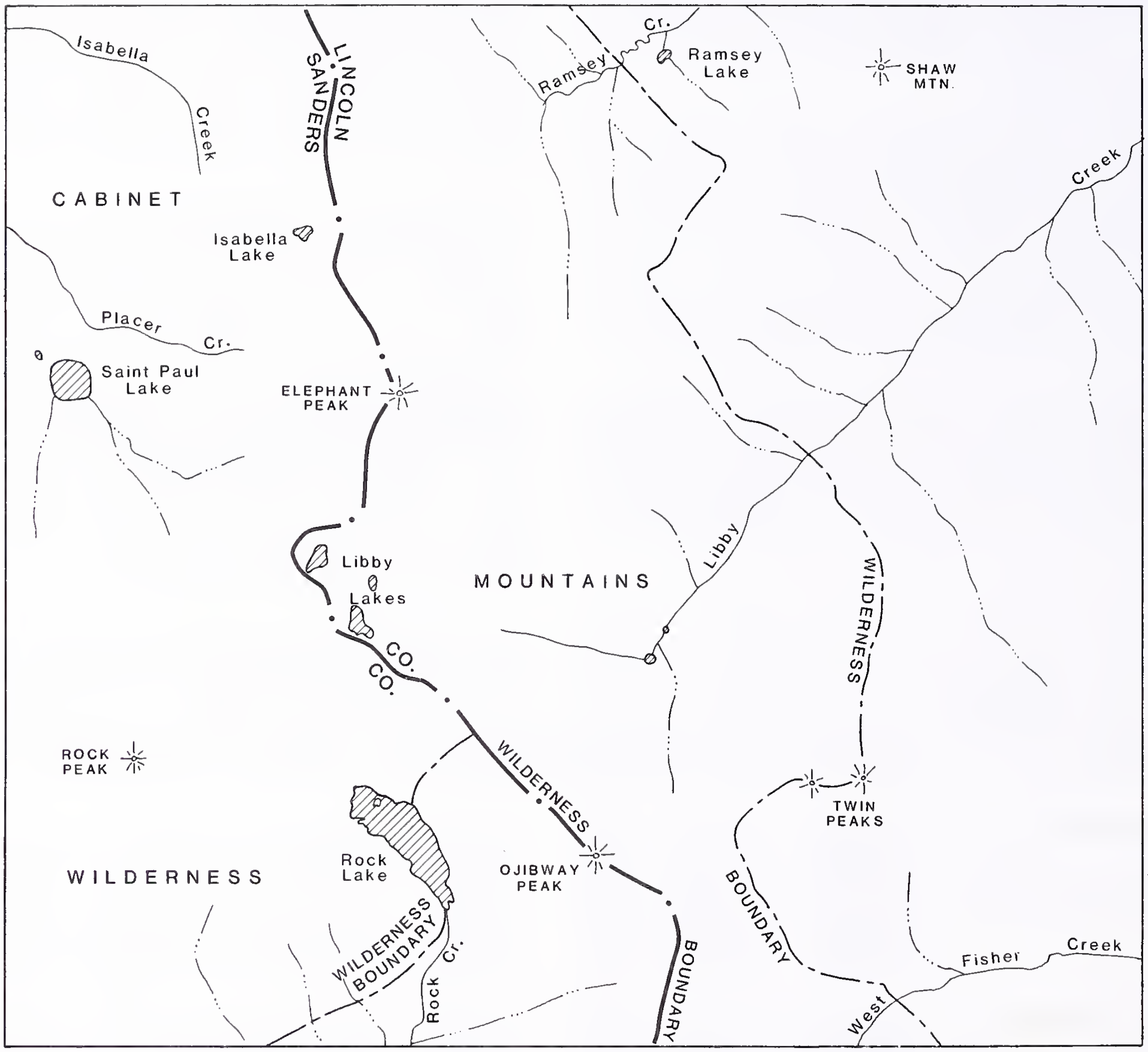
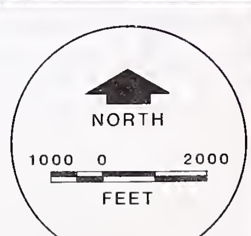


FIGURE 3-6.

MOUNTAIN
LAKES IN
PROJECT AREA



Water Use

Surface water in the project area is put to a variety of beneficial uses including domestic water supply, irrigation, mining, stock watering, fish habitat, and wildlife. The DNRC conducted a file search to determine existing surface and ground water diversions along Libby Creek from the mine area to the confluence with the Kootenai River. Sixty water rights are on record with the DNRC for surface water, including the use of springs, and diversions along Bear, Little Cherry, Poorman, Ramsey and Libby creeks. Most of the recorded surface water permits are for domestic, irrigation, and mining or industrial use. Nearly all of the 277 ground water permits in the area are for domestic use. Noranda holds four temporary water use permits, three for exploratory drilling and one for dust control.

Surface Water Quality

The Kootenai River basin includes some of the purest waters in America; concentrations of dissolved chemicals are among the lowest in Montana (DHES, undated). Streams in the project area are classified by the DHES as B-1 streams, which are suitable for drinking, culinary, and food preparation purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life; waterfowl and furbearers; and agricultural and industrial uses. Streams in the wilderness are classified as A-1 streams, a higher water quality classification.

Baseline surface water quality from the mine area streams is summarized in Table 3-9. Surface waters are a mixed-cation bicarbonate-type water. Total suspended solids, total dissolved solids, major ions, and nutrient concentrations were all very low, frequently at or below analytical detection limits. Field pH measurements ranged from 6.3 to 7.2. Total suspended solids averaged less than 3 mg/L; average total dissolved solids were less than 31 mg/L. Major ion concentrations were generally too low to identify a dominant cation.

Generally, total dissolved solids concentrations, major ion concentrations, and some minor ions such as iron increased downstream in Libby Creek and its tributaries (Table 3-9). The highest average total dissolved solids concentrations were found at the downstream station in Little Cherry Creek.

Metal concentrations were also generally low. Aluminum, arsenic, chromium, manganese, molybdenum, and zinc concentrations were consistently below detection limits. Low concentrations of iron, copper and silver were found at most sampling stations. The presence of copper and silver is probably related to local mineralization. Mercury was found at or below detection limit concentrations at all sampling locations. Cadmium in all surface water samples resulted from sample contamination; analytical results do not reflect baseline conditions.

Seasonal variation occurs in surface water quality. Nutrient concentrations (nitrate and nitrite as N, total phosphorous, and orthophosphate) increased during spring runoff. Total dissolved solids decreased during spring runoff and increased during low flow periods, while total suspended solids increased slightly during spring runoff. Concentrations of certain metals, such as silver and copper, occurred at their highest during spring runoff and declined to at or below detection limits during low flow conditions.

Ground Water

Ground water investigations conducted by Noranda were limited to the mine area. Ground water in the transmission line corridor area would not be affected by the project.

Three hydrogeologic systems govern the amount, distribution, and flow of ground water in the mine area. They are—

- bedrock ground water systems;
- valley-fill ground water systems in narrow mountain valleys; and
- a glaciofluvial/lacustrine ground water system along the eastern flank of the Cabinet Mountains.

Table 3-9. Surface water quality data—Libby Creek and tributaries.§

Parameter / Station No.†—>	Libby Creek: Above adit (LB 100)	Below adit (LB 200)	Above Howard Creek (LB 500)	Above Ramsey Creek (LB 800)	Above Lt. Cherry Creek (LB 2000)	Down-stream of mine area (LB 3000)
Specific conductance (µmhos/cm)	9.7	11.9	14.6	26.2	30.4	53.3
pH (standard units)	6.9	6.7	6.7	7.1	7.1	7.2
Temperature (°C)	6.5	6.2	5.7	6.4	10.4	7.0
Total Phosphorus (mg/L)	0.005	0.007	0.007	0.018	0.006	0.006
Orthophosphate (mg/L)	<0.005	0.007	0.005	0.005	0.006	0.006
Nitrate/Nitrite Nitrogen (mg/L)	0.12	0.13	0.09	0.07	0.06	0.09
Ammonia (mg/L)	0.08	0.08	0.07	0.07	<0.08	0.07
Total Kjeldahl Nitrogen (mg/L)	<0.20	0.20	<0.20	<0.20	<0.20	0.20
Total suspended solids (mg/L)	1.8	1.6	1.3	1.7	1.6	1.9
Total dissolved solids (mg/L)	9.4	11.0	15.6	16.9	20.0	29.0
Turbidity (NTU)	0.42	0.38	0.3	0.43	0.51	0.90
Oil & Grease (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	1.6
Major cations (mg/L)						
Calcium	1.0	1.0	1.0	1.0	3.2	5.4
Magnesium	<1.0	<1.0	<1.0	<1.0	1.1	1.4
Sodium	1.3	1.1	1.8	1.8	1.4	1.3
Potassium	1.2	1.3	1.3	1.3	1.7	1.3
Major anions (mg/L)						
Bicarbonate (as HCO_3)	5.8	6.1	8.1	13.1	20.8	29.8
Chloride	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sulfate	1.6	1.4	2.1	1.3	1.4	1.8
Total Hardness (as $CaCO_3$)	<5.7	<5.7	<5.8	5.6	9.8	17.5
Total Alkalinity (as $CaCO_3$)	4.8	5.1	6.5	10.7	17.2	23.9
Fluoride	0.06	0.06	0.05	0.06	<0.05	0.06
Total recoverable metals (mg/L)						
Aluminum	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0012	0.0018	0.002	0.0007	0.0004	0.002
Chromium	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.001	0.002	0.002	0.002	0.002	0.002
Iron	<0.05	<0.05	0.05	0.05	0.05	0.08
Lead	<0.001	<0.001	<0.001	0.001	<0.001	0.001
Manganese	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.0002	<0.0003	0.0003	0.0002	0.0003	0.0003
Zinc	0.02	0.02	<0.02	<0.02	<0.02	0.02

Source: Chen-Northern, Inc. 1989. Appendix G.
§Average values for baseline year in mg/L; some averages include values less than the analytical detection limit.
†See Figure 3-5 for station locations.

Table 3-9. Surface water quality data—Libby Creek and tributaries (con't).[§]

Parameter / Station No.[†]—>	Ramsey Creek at mouth (RA 600)	Little Cherry Creek (LC 600)	Bear Creek (BC-100)
Specific conductance (µmhos/cm)	17.2	46.7	72.4
pH (standard units)	6.7	7.1	7.5
Temperature (°C)	5.7	6.8	8.8
Total Phosphorus (mg/L)	0.035	0.008	0.006
Orthophosphate (mg/L)	0.013	0.007	0.006
Nitrate/Nitrite Nitrogen (mg/L)	0.066	0.3	0.194
Ammonia (mg/L)	0.07	0.07	<0.08
Total Kjeldahl Nitrogen (mg/L)	0.29	0.20	<0.20
Total suspended solids (mg/L)	1.4	2.5	1.4
Total dissolved solids (mg/L)	10.6	30.6	40.9
Turbidity (NTU)	0.35	1.35	0.37
Oil & Grease (mg/L)	<1.0	<1.0	<1.0
Major cations (mg/L)			
Calcium	1.0	3.4	10.2
Magnesium	<1.0	1.2	1.5
Sodium	1.7	2.1	1.1
Potassium	1.2	1.4	1.2
Major anions (mg/L)			
Bicarbonate (as HCO_3)	7.4	25.1	45.6
Chloride	<1.0	<1.0	<1.0
Sulfate	2.2	1.6	1.5
Total Hardness (as $CaCO_3$)	<5.8	12.5	30.2
Total Alkalinity (as $CaCO_3$)	6.2	19.9	37.3
Fluoride	0.06	0.06	0.06
Total recoverable metals (mg/L)			
Aluminum	<0.10	0.12	<0.10
Arsenic	<0.005	<0.005	<0.005
Cadmium	0.002	0.003	0.002
Chromium	<0.02	<0.02	<0.02
Copper	0.002	0.002	0.002
Iron	0.05	0.08	0.05
Lead	0.001	0.001	<0.001
Manganese	<0.02	<0.02	<0.02
Mercury	0.0002	0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05
Silver	0.0003	0.0003	0.0003
Zinc	0.02	<0.02	<0.02

Source: Chen-Northern, Inc. 1989. Appendix G.
[§]Average values in mg/L; some averages include values less than the analytical detection limit.
[†]See Figure 3-5 for station locations.

Bedrock ground water. Bedrock in the mine area generally has low primary porosity and permeability. Unfractured metasedimentary deposits (quartzite and siltite) normally have hydraulic conductivities (a coefficient describing the rate at which water can move through a permeable material under standard conditions) ranging from 10^{-7} to 10^{-11} centimeters per second (cm/sec.), and cannot store or transmit ground water. Ground water primarily occurs in fractures (joints or faults) in the bedrock. The bedrock in the mine area is generally highly fractured. In addition to major fractures such as the Rock Lake Fault and the Snowshoe Fault, three joint sets have been identified. Fractured bedrock has hydraulic conductivities ranging from 10^{-4} to 10^{-6} cm/sec.

Bedrock ground water is recharged by infiltration of precipitation and snowmelt and by seepage from high mountain streams. The ground water systems are unconfined, and water levels within the fractured bedrock define a water table. The ground water table generally parallel surface topography, but are somewhat subdued. Ground water flows along fracture trends (north-northwest and east-northeast) toward topographic lows, discharging to high mountain lakes, springs, streams and unconsolidated valley-fill deposits.

Bedrock ground water tables are expressed in lake levels, springs, and in water levels observed during drilling. Ground water encountered at drill sites near Rock Lake and St. Paul Lake indicate static water levels approximating those of nearby lakes. Drilling at other sites encountered deeper static water levels or encountered no static water level at all. The high degree of variability exhibited by the borehole records reflects the complexity and lack of horizontal or vertical interconnection in the fracture systems.

Valley-fill ground water. Ground water systems in the valley-fill deposits in narrow mountain valleys are limited. These deposits contain colluvial, alluvial, and glacial materials in a heterogeneous mixture of clay, silt, sand, and larger-sized particles. Valley-fill deposits follow the valley bottoms and are not extensive or continuous—in some places, bedrock outcrops along the stream channel bottoms. Geophysical surveys indicate the valley-fill deposits to be 30 to 70 feet deep at the Libby Creek adit site, and 24 to 70 feet deep at the plant site. Ground water was encountered during drilling at depths of 12 to 16 feet at the Libby Creek site and at 22 feet at the Ramsey Creek site.

The valley-fill systems are recharged by precipitation and snowmelt, by stream flow, and by discharge from bedrock ground water systems. Ground water flow is down-valley. The systems discharge to surface water or to more extensive glaciofluvial-lacustrine deposits along the mountain front.

Glaciofluvial/lacustrine ground water. In the tailings impoundment area, ground water occurs as perched water and under artesian conditions in unconsolidated glaciofluvial and lacustrine deposits. These glacial deposits form a wedge along the eastern flank of the Cabinet Mountains, beginning at an elevation of approximately 4,000 feet and increasing in depth away from the mountains. These deposits range in thickness from zero at bedrock outcrops near the Little Cherry Creek impoundment site to over 200 feet in the Poorman Creek area.

The glaciofluvial and lacustrine deposits are interfingered, and, at many locations, lacustrine deposits overlie glaciofluvial deposits. The lacustrine deposits are finer grained and act as a barrier to ground water flow. In the Little Cherry Creek area, a buried pre-glacial valley underlies the lacustrine deposits. This valley has been abandoned and is filled with over 275 feet of fluvial sediments similar to the glaciofluvial deposits.

The glaciofluvial/lacustrine ground water system is recharged by precipitation, snowmelt, and streamflow along the flank of the mountains. Ground water flow is generally easterly following the surface topography (Figure 3-7). The potentiometric surface gradient is low, approximately 0.08 in the Poorman Creek area and 0.05 across the Little Cherry Creek

area. Ground water in the tailings impoundment area discharges to Bear Creek and Libby Creek. Some of the water flowing beneath the tailings impoundment site discharges as springs in the proposed dam site area and downstream.

Aquifer tests were conducted in the glaciofluvial deposits and in the filled channel in the tailings impoundment area. The hydraulic conductivity of the glaciofluvial deposits range from 0.05 to 145 gpd/ft^2 (7 x 10^{-3} to 2 x 10^{-6} cm/sec.), with a mean of 51.5 gpd/ft^2. Estimates of transmissivity (a measure of the rate at which ground water is transmitted through a unit width of aquifer) range from 1.3 to 945 gpd/ft, with a mean of 455 gpd/ft. Estimates of the hydraulic conductivity and transmissivity of the filled channel ranged from 0.5 to 2.7 gpd/ft and 25 to 120 gpd/ft^2, respectively.

Hydraulic conductivities of the lacustrine deposits ranged from less than 0.2 to 0.85 gpd/ft^2 (<10^{-6} to 4 x 10^{-5} cm/sec.). Although saturated, the fine-grained lake deposits did not yield measurable water in the boreholes. The lacustrine deposits act as confining layers where they overlie more permeable deposits. Where the lacustrine deposits underlie more permeable deposits, perched conditions exist.

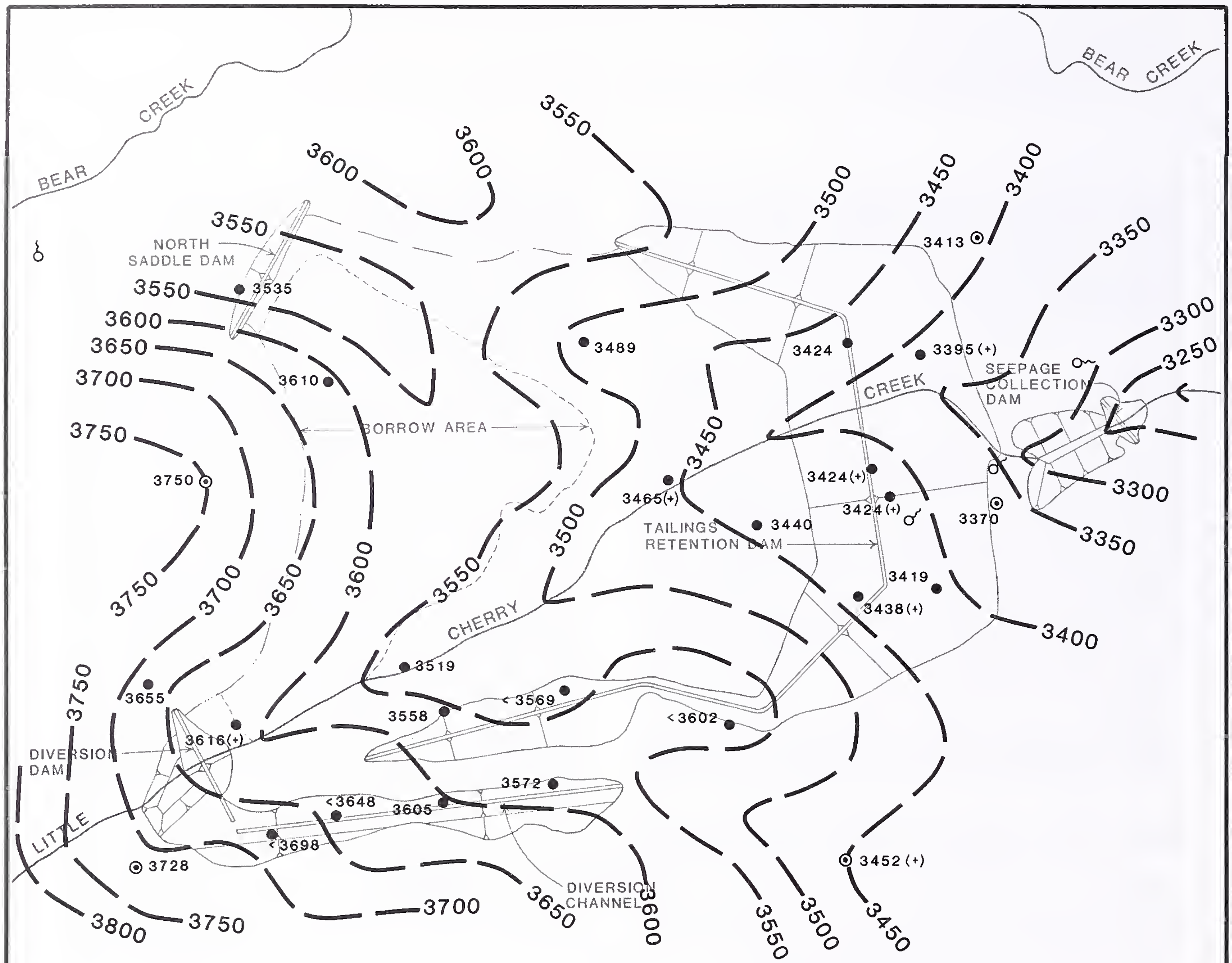
The glaciofluvial deposits are capped by the relatively impermeable lacustrine deposits. These deposits allow hydraulic pressures to build and create the confined (or artesian) flow conditions observed in the Poorman Creek and Little Cherry Creek areas. In the tailings impoundment area, the water levels observed in monitoring wells are quite variable, ranging from below the bedrock-soil contact to above the ground surface, indicating artesian conditions.

Well, spring, and adit inventory. No existing wells were identified in the mine area. The nearest well to the mine area is located at the Howard Lake Campground. Several springs (Table 3-10) and one

Table 3-10. Springs occurring in the mine area.

Spring	Location	Elevation (feet)	Discharge (gpm)	Geologic source
Tailings impoundment area				
SP-01	Below saddle between Bear Creek and Big Cherry Creek	3,500	2-3	Lacustrine silts
SP-02	Little Cherry Creek	3,320	1-2	Lacustrine silts
SP-10	Little Cherry Creek	3,350	1	—
SP-11	West side of Libby Creek	3,370	0.5	—
SP-12	West side of Libby Creek	3,390	—	—
SP-13	South side of Bear Creek	3,410	—	—
SP-14	West side of Libby Creek	3,350	0.2	—
SP-15	Little Cherry Creek	3,420	1.5-2.0	—
SP-17	South side of Bear Creek	3,560	0.5	—
SP-18	South side of Bear Creek	3,550	2.0	—
Other springs in project area				
SP-03	Lower east slope of Cable Mountain	4,320	4-5	Colluvium
SP-04	Upper Libby Creek	4,200	8.9	Colluvium
SP-05	Rock Creek, NE of Heidelberg Mine	4,350	5-7	–
SP-16	Rock Creek, SE of Heidelberg Mine	4,450	40-50	Bedrock

Sources: Chen-Northern, Inc. 1989. p. 4-14.
Noranda Minerals Corp. 1989h. p. 24-26.
Chen-Northern, Inc. 1990. Appendix D.



Source: Morrison-Knudsen Engineers, Inc. 1989c.

LEGEND

- ● Boring, With Piezometric Pressure Head. (+) Where Flow Is Artesian At Surface
- ⊙ Monitor Well (By Chen-Northern)
- Spring
- — — Approximate Contour of Piezometric Head

FIGURE 3-7.

GROUND WATER LEVELS IN THE PROPOSED TAILINGS IMPOUNDMENT AREA

NORTH

0 400 800

FEET

discharging mine adit (the Heidelberg adit) were identified in the mine area. Most identified springs occur in the Little Cherry Creek and Bear Creek drainages (Figure 3-7). These springs are relatively small, discharging less than 4 gpm. Other springs in the project area (Table 3-10) originating from colluvium or bedrock discharge at higher rates (4-50 gpm). High mountain springs observed in the area (T. Webster, DSL Hydrologist, pers. comm. w/ J. Zimpfer, April 26, 1990) may be related to a ground water system along the Rock Creek Fault, and flows show large fluctuations from spring to summer.

During hydrologic baseline studies by Chen-Northern, Inc.(1989), the Heidelberg Mine adit, near the head of Rock Creek, was observed to flow in the spring; in the summer, only standing water was observed. During geotechnical evaluation of the Heidelberg Mine adit by Morrison-Knudsen in August, 1989, ground water flow in the adit was estimated to be 80 gpm.

Ground Water Quality

Baseline ground water quality monitoring was conducted primarily in the ground water system at the tailings impoundment site. Ground water samples from monitoring wells in the tailings impoundment area show the existing water quality to be very good. Ground water is a calcium bicarbonate or calcium-magnesium bicarbonate type. Measured total dissolved solids were low (<120 mg/L), and pH values were near neutral (generally 7.4 to 7.6). Most metals concentrations were at or below analytical detection levels. Manganese and cadmium were the only trace metals consistently identified in ground water samples (Table 3-11).

Manganese concentrations were low, averaging 0.24 mg/L and less. The cadmium concentrations are the result of sample quality control problems and do not represent baseline conditions. Low concentrations of iron and aluminum were identified in some samples.

Seasonal variations occur in nitrate and nitrite concentrations for all monitoring wells except the deep, artesian well in the Poorman Creek area. Nitrate and nitrite concentrations (as N) were lowest in January. Bicarbonate and total dissolved solids concentrations were slightly higher in August and October than in January and March. Manganese concentrations decreased from August through March. Other trace metals concentrations show no seasonal variations.

Limited information is available on bedrock ground water quality. Under the DSL permit to construct the Libby Creek adit, Noranda is collecting water samples for analysis. Results are similar to those found during August sampling in the tailings impoundment area (Table 3-11). Except for manganese, all metal concentrations were below the detection limit.

Chen-Northern, Inc. (1990) sampled a bedrock spring (SP-16) near the Heidelberg Mine during July, 1989. Concentrations of all analytical parameters were very low, with all metals except molybdenum below the detection limit (Table 3-11). Total dissolved solids and total hardness are also below detection limits, indicating the water contains few dissolved constituents.

AQUATICS

Noranda's aquatic biology baseline studies encompassed reaches in five study area streams. Physical habitats were evaluated using the General Aquatic Wildlife System (GAWS) of the U.S. Forest Service (1985 and 1988). This system calculates indices for riparian habitat condition, fishery habitat condition, and habitat vulnerability.

Physical Characteristics

Riparian habitat condition was found to be good or excellent throughout the study reaches, with the exception of the braided reach of Libby Creek, below its confluence with Poorman Creek, which was fair. The physical effects of abandoned placer mining operations are evident throughout this reach.

The habitat vulnerability index rates sites for their potential susceptibility to aquatic habitat degradation.

Table 3-11. Ground water quality in the project area.

Parameter	Tailings impoundment area August 1988	October 1988	January 1989	March 1989	SP 16 July 1989	Libby Creek adit
Specific conductance (μmhos/cm)	198	179	139	150	18	198
pH (standard units)	7.4	7.4	7.4	7.6	7.1	7.8
Temperature (°C)	9.7	8.2	8.1	6.6	4.5	—
Total hardness as $CaCO_3$	103	88	74	95	<7	96
Nitrate/nitrite nitrogen (mg/L)	0.54	0.83	0.09	0.50†	<0.07	0.10
Total dissolved solids (mg/L)	119	114	90	104	<20	119
Total alkalinity as $CaCO_3$ (mg/L)	117	100	76	94	7	112
Major cations (mg/L)						
Calcium	25	21	—†	22	1	25
Magnesium	11	9	9	10	<1	8
Sodium	11	6	5	—†	<1	10
Potassium	3	2.3	5	3.4	<1	<1
Major anions (mg/L)						
Bicarbonate	135	122	93	115	9	123
Carbonate	4	N.D.	N.D.	N.D.	N.D.	7
Sulfate	3	4	—†	5.6	<1	10
Chloride	2	1.4	—†	1.4	<1	1
Fluoride	0.06†	0.18†	0.11	0.08	<0.05	0.10
Metals (mg/L)	Total recoverable				Dissolved	
Aluminum	<0.1	0.19	<0.1	0.4	<0.1	<0.1
Arsenic	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.003†	0.002	—†	0.004	<0.0005	<0.001
Chromium	<0.02	0.02	<0.02	0.02	<0.02	<0.02
Copper	0.02	<0.02	<0.01	<0.01	<0.01	<0.01
Iron	<0.05	0.13	<0.05	0.25	<0.05	<0.05
Lead	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	0.24	0.18	0.14	0.04	<0.02	0.06
Mercury	<0.0002	—†	0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05	0.05	<0.05
Silver	0.001	0.001	<0.001	<0.002	<0.001	<0.001
Zinc	0.08	0.03	<0.02	0.02	<0.02	<0.02

Source: Chen-Northern, Inc. 1989, Appendix J.
Chen-Northern, Inc. 1990, Appendix E
Noranda Minerals Corp. 1990

Values are averages and include some values below the analytical detection limit.

N.D. - not detected.

†Analyses subject to quality assurance problems.

Portions of the lower two sampling reaches in Libby Creek, all reaches of Ramsey Creek, and the upper reaches of Bear Creek were rated as potentially vulnerable to degradation. Other reaches of the study area rated moderate to low in vulnerability potential.

The habitat condition index is a general measure of potential fishery habitat. For streams in the project area, index components measuring bank cover and stability were high, while measures of pool quality and quantity were typically lower, resulting in an overall reduction in area stream scores. Habitat condition values for project area streams are shown in Table 3-12.

Average potential spawning areas for the surveyed stream reaches range from four percent for the Ramsey Creek upper reach to 45 percent for the downstream reach of Libby Creek. Gravel substrates generally account for 20 to 40 percent of the streambed at the Libby Creek sampling stations. Average potential rearing area ranges from eight percent in Poorman Creek and the upper reach of Libby Creek, to 99 percent for the upstream reach of Ramsey Creek. The most likely locations for spawning in Libby Creek include reaches downstream from its confluence with Bear Creek, near its confluence with Poorman Creek, downstream from Ramsey Creek, and downstream from Howard Creek.

Table 3-12. Habitat condition values for project area streams.

	——Range——		
Creek	Min.	Max.	Average
Bear	59	87	76
Little Cherry	55	82	66
Libby	50	83	70
Poorman	59	62	60
Ramsey	48	82	63

Source: Western Resource Development Corp. 1989a., p. 22.

Other probable spawning areas for streams draining the project area include reaches in Bear Creek downstream from the Bear Creek Road, and the reach of Poorman Creek above its confluence with Libby Creek.

Chemical Characteristics

Dissolved mineral and nutrient concentrations in the streams are generally near or below their respective analytical detection limits. These extremely low concentrations severely limit the productivity potential for aquatic life.

Because of very low alkalinities, the streams in the project area are very poorly buffered. Consequently, surface waters tend to be slightly acid (pH 6 to 7). This acidity has two likely natural sources—organic acids originating from surrounding coniferous forests, and dissolved carbon dioxide (CO_2) both in surface waters and soil waters draining into the area streams. Water hardness in the Libby Creek drainage is at or below detection limits for most samples analyzed. In some locations, maximum hardness is 5 mg/L as calcium carbonate ($CaCO_3$).

Aquatic Insects

Macroinvertebrate (aquatic insect) densities average 1,800 organisms per square meter to 2,500 organisms per square meter. (The lower density is attributable to the occurrence of a heavy rainstorm immediately prior to sample collection.) In total, 144 different types of macroinvertebrates were identified. Midges, mosquitos and flies are the most diverse group, and caddisflies, stoneflies, and mayflies are very common. Most macroinvertebrates are considered intolerant of fine sediments, heavy metals, and organic pollution.

Calculated indices characterizing macroinvertebrate communities indicate excellent water quality in the project area streams. Differences in community characteristics among the stations are generally slight. These differences are probably due to differ-

ences in stream order, microhabitat conditions, and variable sampling efficiencies.

For all sampling stations in the Libby Creek drainage system, average dry weight biomass for benthic macroinvertebrates ranged from a minimum of 0.03 g/m^2 at the most upstream station to 0.42 g/m^2 at the most downstream station of Bear Creek. Using U.S. Forest Service (1985) criteria based on macro-invertebrate biomass, the potential to support fisheries in all project area stream reaches is rated as poor. The low benthic macroinvertebrate populations directly reflect the low nutrient concentrations in the mine area streams.

Aquatic Plants

Larger aquatic plants occur only incidentally. A few sprigs of water buttercup are found in spring seeps in the Libby Creek floodplain. Mosses are the predominant vegetation found along many stream reaches. They are particularly abundant in upstream portions of each stream, and are present wherever stable substrates and dense forest canopies occur. Mosses are essentially absent from Libby Creek's middle reaches.

Sparse growth of green algae, blue-green algae, and diatoms occur throughout the study area. In general, the algal taxa found were typical of unpolluted, softwater streams in Montana. The low population densities, common of high-elevation streams, reflect the low productivities and low nutrient contents in the Libby Creek drainage waters.

FISHERIES

Rainbow trout is the dominant trout species in all study area streams, ranging from 63 percent of the sampled population in Ramsey Creek, to 100 percent of the sampled population in Little Cherry Creek. Trout densities are low, exceeding one trout per 100 linear feet only in Little Cherry Creek. Trout populations are further characterized in Table 3-13.

Most fish at the downstream Poorman Creek site were sculpins. While the species of sculpin are unknown, it is likely that they are shorthead, spoonhead, or torrent sculpins.

Most trout were young (age I, II, and III). This is typical for low productivity mountain streams. Older (age IV) rainbow trout were found only in Ramsey Creek, while age IV bull trout were found in

Table 3-13. Rainbow and bull trout population characteristics in project area streams.

Stream	Densities (fish/100 ft^2)	rainbow trout average length (in.)	rainbow trout average weight (oz.)	bull trout average length (in.)	bull trout average weight (oz.)
Libby Creek (between Little Cherry and Bear creeks)	0.4	4.9	0.8	4.8	0.5
Libby Creek (upstream of Ramsey Creek)	0.2	not found		7.5	4.0
Ramsey Creek (upstream of Libby Creek confluence)	0.5	4.9	1.0	5.4	1.4
Poorman Creek (upstream of Libby Creek confluence)	0.8	4.7	0.8	6.6	1.8
Little Cherry Creek (upstream of Libby Creek confluence)	1.7	3.7	0.4	not found	

Source: Western Resource Development Corp. 1989a. pp. 53, 56, and 58.

upstream reaches of both Ramsey Creek and Libby Creek. Age V bull trout were found only in the upstream reach of Ramsey Creek. Growth rates for all age classes are low, primarily due to limitations caused by extremely low nutrient concentrations.

During the baseline study, two spawning areas made by large, apparently migratory bull trout were found below the falls on Libby Creek (downstream of the project area). Above the falls, ten small bull trout redds were also found, which were obviously the product of resident fish. No spawning was observed in Ramsey Creek or Poorman Creek. Also, no spawning by mountain whitefish was observed.

Portions of all three transmission line routes follow and cross the Fisher River. This section of the river holds resident rainbow trout and mountain whitefish and migratory rainbow, whitefish, and bull trout. The Miller Creek and North Miller Creek routes run along the north side of Miller Creek. Rainbow trout are the predominant species in the creek, comprising 73 percent of the fish population. Other fishes include cutthroat trout (16 percent); brook trout (9 percent); and sculpin (2 percent). Only 20 fish of the 290 fish sampled (7 percent) were over 7 inches long—the longest being a 9-inch brook trout (D. Perkinson, KNF biological science coordinator, pers. comm., w/ Scott McCollough, DNRC), January, 1990; written comm. to , and J. Huston, DFWP fishery biologist, pers. comm., January, 1990). The Swamp Creek alternative transmission line route crosses Schrieber Creek; it is expected to have fish populations similar to Miller Creek.

Heavy Metals

Concentrations of five metals in rainbow trout muscle are shown in Table 3-14. Except for mercury, regulatory criteria for metals concentrations in fish have not been established. The U.S. Food and Drug Administration has established a mercury standard of one µg/g. Concentrations of mercury in the sampled fish are below this standard.

Table 3-14. Metals concentrations in rainbow trout—Libby Creek (in µg/g).

Metal	Range Min.	Range Max.	Average
Cobalt	0.1	12.4	1.9
Copper	2.4	29.4	6.5
Lead	<0.1	<1.4	<0.5
Mercury	0.1	0.4	0.19
Zinc	22.3	62.8	30.1

Source: Western Resource Development Corp. 1989a. pp. 69-70.

Threatened, Endangered, or Sensitive Fish Species

No fish species listed as threatened or endangered by the U.S. Fish and Wildlife Service were found. Bull trout, however, are currently under a Notice of Review, Category 2 status, which is applied to a species which may be threatened or endangered, but for which there is not substantial biological information. The KNF classifies white sturgeon, inland rainbow trout, and westslope cutthroat trout as sensitive. These species are classified as historically known, critically imperiled, and rare, respectively, by the Montana Natural Heritage Program. Although not found during the baseline study of the Libby Creek drainage, these three fish species might inhabit streams within or downstream of the project area.

The KNF also classifies torrent and shorthead sculpin as sensitive; while the MNHP classifies them as imperiled and rare, respectively, and the spoonhead sculpin as critically imperiled. At least one of these three species is likely to be the unidentified sculpin species collected in Poorman Creek and Miller Creek.

WILDLIFE

The project area supports abundant and diverse wildlife populations. During the baseline surveys, 35 mammal species, 10 raptor species, 94 other

breeding bird species, three reptile, and five amphibian species were recorded in the study area. (The study area encompassed an area larger than the project area. See Chapter 6 for more discussion of collection of wildlife baseline data.) Common and scientific names for species recorded in the wildlife study area are available in the KNF project file and in the baseline report (Western Resource and Development, 1989d).

Forty-three species of special concern potentially inhabit the project area. Four of these species (northern Rocky Mountain wolf, woodland caribou, bald eagle and peregrine falcon), are listed as endangered; the grizzly bear is listed as threatened by the U.S. Department of Interior. Two others, wolverine and lynx, are considered candidate species which may be suitable for listing, but sufficient data are lacking to do so at the present time. Species of special concern are discussed in greater detail in a subsequent section.

Habitat Types

The habitat types found in the project area are typical for the Northern Rocky Mountains. Eleven wildlife habitat types are present in the mine area (Table 3-15). Four of these types account for almost 85 percent of the mine area. Each habitat type is briefly described in the following sections. Information on wildlife habitats in the transmission line corridor area is presented following the habitat type descriptions.

Mixed conifer. Mixed conifer habitat encompasses about 34 percent of the mine area. It is characterized by a visually dominant tree canopy comprising a variety of tree species. It provides hiding and thermal cover for moose, white-tailed deer, mule deer, elk, and black bear. Some portions of the habitat have an ample understory which also provides forage for big game. Fifty species of breeding birds and eight species of small mammals were identified in this habitat. Common species are Townsend's warbler, golden crowned kinglet, pine siskin, red-tailed chipmunk, and bushy-tailed woodrat. Black swift, downy woodpecker and mountain bluebird occurred only in mixed conifer habitat.

Clearcut. Clearcut habitat comprises 23 percent of the mine area. Vegetation in clearcut habitat varies with the age of the clearcut. Young habitat is dominated by shrubs and forbs. As they age, clearcut habitats mostly comprise of coniferous trees. During the baseline surveys, 48 species of breeding birds and five species of small mammals were found in clearcut habitats. Common species include dark-eyed junco, pine siskin, chipping sparrow and deer mouse. American kestrel, northern pygmy owl, common nighthawk, black-billed magpie, house wren and cedar waxwing occurred only in clearcut habitat.

Spruce-fir. Spruce-fir habitat occupies 15 percent of the proposed project area. It is dominated by Engelmann spruce and subalpine fir. It provides cover for most of the big game species in the area. It is particularly important to mountain goats during the

Table 3-15. Wildlife habitat types in mine area (in acres).

Habitat type	Mine area	Study area†
Riparian	589	711
Western hemlock	358	725
Mixed conifer	2,654	9,819
Clearcut	1,755	3,256
Shrub field	904	4,285
Spruce-fir	1,195	6,469
Rock	124	4,362
Grassland	58	1,365
Lodgepole pine	59	232
Forb field	15	152
Aquatic	15	105
Total	7,727	31,481

Source: Western Resource Development Corp. 1989d. p. 41.
†See Chapter 6 for delineation of wildlife study area

winter, when it provides both food and cover. Spruce-fir is used by 58 species of breeding birds, such as Swainson's thrush, winter wren and least flycatcher, and seven species of small mammals. Sighting of great horned owl, Clark nutcracker and red squirrel occurred only in spruce-fir habitat of the mine area.

Rock. Rock habitat comprises 1.6 percent of the mine area. It is found primarily in alpine areas. Steep rock faces, which comprise a portion of the habitat, provide escape terrain and foraging for mountain goats. Rock habitat also provides potential nesting areas for raptors, such as golden eagle and prairie falcon, although none was found during surveys of the mine area.

Shrubfield. Shrubfield habitat constitutes 12 percent of the mine area. It contains a wide variety of shrubs, which provide food and cover for black bear, mule deer, white-tailed deer, moose and elk. Fifty-seven species of breeding birds and six species of small mammals were found in shrubfields during the baseline surveys. Common species include Rufous hummingbird, MacGillivray's warbler, chipping sparrow, and deer mouse. Lincoln's sparrow, white-crowned sparrow and American goldfinch occurred only in shrubfield habitat.

Riparian. Riparian habitat is found along stream courses and around lake shores. It is limited in extent and covers 7.6 percent of the mine area. Even though its extent is limited, riparian areas are an important habitat type, having the highest density, most individuals, and most species of breeding birds, indicating that it is the most diverse and productive habitat in the mine area. It is the main habitat type used by moose and white-tailed deer. It also provides forage for black bear, mule deer and elk. During the baseline surveys, 63 species of breeding birds and six species of small mammals were observed in riparian habitat. Common species include American robin, black-capped chickadee, song sparrow, red-tailed chipmunk and deer mouse. Nine avian species, mallard, common snipe, belted kingfisher, tree swallow, violet-green swallow, veery, vesper sparrow, western meadowlark, and Brewer's blackbird occurred only in riparian habitat.

Western hemlock. Western hemlock habitat comprises 5 percent of the proposed project area. It provides hiding cover for most big game species and is the least diverse habitat type, supporting only 37 species of breeding birds and five species of small mammals. Common species include golden-crowned kinglet, chestnut-backed chickadee, red-breasted nuthatch and deer mouse. Only one species, barred owl, was found exclusively in western hemlock habitat.

Other wildlife habitat types. Four other wildlife habitat types—grassland, lodgepole pine, forbfield and aquatic—each occupy less than one percent of the mine area. Although they are important to some wildlife species, they are very minor components of the study area and were not sampled for breeding birds and small mammals during the baseline surveys.

Lodgepole pine may be expected to provide cover for big game; grassland provides forage for most big game species; and aquatic habitat provides water for a variety of wildlife species, including waterfowl and shorebirds. Grassland occurs along valley bottoms and lower mountain sideslopes. It provides forage for a number of big game species and forage and cover for small mammals.

Habitat types of the transmission line corridor. Most descriptions of wildlife habitat types of the mine area also apply to wildlife habitat types in the transmission line corridor. The mine area types are more finely divided (Table 3-16). All routes for the transmission lines cross similar mileages of wildlife habitat types and may affect stands of old growth timber. These stands, supplying important habitat for some species of special concern, are managed for wildlife by the KNF.

Important Wildlife Species

Nine big game species, several species of waterfowl, three upland game bird species and assorted predators, small mammals and song birds occur in the project area. Included in these are seven KNF Management Indicator Species (MIS).

Black bear. The Cabinet Mountains support some of the highest black bear densities in Montana, with 47 black bears observed during the baseline surveys. Black bears range throughout the project area. During spring, they are mostly found below snowline throughout the mine area including the Libby, Poorman, and Ramsey drainages; in summer, they concentrate on Great Northern Mountain and in the upper reaches of Rock Creek. Peak black bear numbers during 1988 in the project area were estimated to be between 108 and 146 bears.

Black bears, as opportunistic feeders, feed on both plant and animal materials. They will eat grasses, forbs, berries, insects, carrion, fish and other animals they have caught. Analysis of 17 spring bear scats in the project area indicates that grasses and forbs, growing primarily on open slopes and meadows, are the bears' primary foods. Berries, such as those found in shrubfields, are eaten when available.

Mountain goat. Mountain goats are an MIS. They are found primarily in alpine habitat and high elevation coniferous forest stands throughout the year (Figure 3-8). They use steep rock outcrops and escarpments for escape from predators, and feed on vegetation found in the rock crevices. They use coniferous timber to escape from severe weather, particularly during winter. Mountain goats eat a wide variety of foods, but in the Cabinet Mountains, shrubs are the major component of their diet year-round. Grasses are also consumed when available. In winter, they browse on trees (Joslin, 1980).

In the project area, 40 to 55 mountain goats were estimated to occupy rocky ridges during 1988/89. Most of the activity is in the Rock Creek, Libby Creek and Fisher Creek drainages, but some solitary males can be found in Ramsey Creek and Poorman Creek areas. During baseline studies, most goats in the area wintered in Rock Creek, but two were observed above Libby Creek and one above Ramsey Creek. The Montana Department of Fish, Wildlife, and Parks has identified the area above Rock Creek as confirmed winter range; the south-facing slopes

Table 3-16. Miles of wildlife habitat types crossed by transmission line route alternatives and corresponding mine area habitat types.

Corridor wildlife habitat type	—Miles crossed by transmission line alternative— 1	4	5	6	Corresponding mine area wildlife habitat type
Coniferous forest	12.8	13.0	11.7	11.5†	Western hemlock Mixed conifer Spruce-fir Lodgepole pine Rock
Clearcut	2.9	2.8	3.6	5.0	Clearcut
Riparian	0.6	0.6	0.6	0.6	Riparian
Wetland	0	0	0	0	Aquatic

Source: Noranda Minerals Corp. 1989c.
†Crosses 0.4 miles of old growth timber as mapped in the KNF Forest Plan and field verified. Other alternatives may also cross old growth timber.

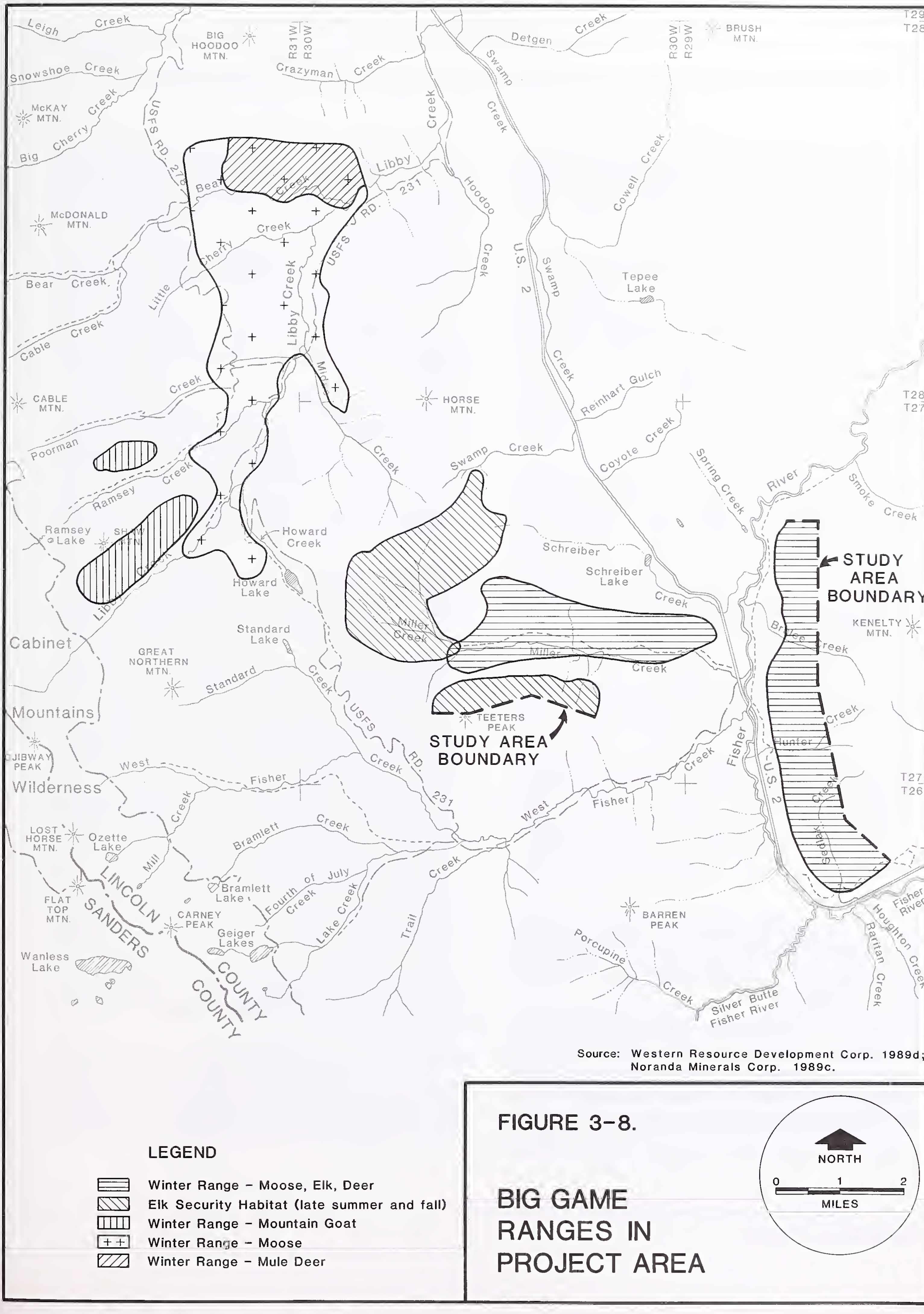


FIGURE 3-8.

BIG GAME RANGES IN PROJECT AREA

above Fisher Creek as probable winter range; and south-facing slopes above Libby, Ramsey and Poorman creeks as possible winter range (Joslin, 1980).

Moose. Moose use riparian habitat throughout the year along the various creeks in the project area. They also use drier mid-elevation areas during summer. Their food consists primarily of shrubs, with some forbs during summer. In the project area, moose concentrate along riparian areas, in 15- to 20-year-old clearcuts with shrubby understories, in shrubfields, and in forested areas with shrubby understories.

During late fall and winter, they concentrate along Little Cherry Creek, Miller Creek, on Big Hoodoo Mountain and west-facing slopes above the Fisher River (Figure 3-8). They also use areas west of Libby Creek between Bear Creek and Howard Creek; there is some winter use along Ramsey Creek and upper portions of Libby Creek. It was estimated that between 60 and 110 moose were in the mine area in December of 1988.

White-tailed deer. White-tailed deer are probably the most abundant ungulate in the project area and are an MIS. Their activity focuses on areas within one mile of riparian habitat along all drainages in the project area. White-tailed deer will browse both deciduous and coniferous trees in winter. In spring, they switch to green grasses and forbs, while the summer diet is high in forbs with some deciduous browse. In fall, they gradually switch back to browse (Peek, 1984).

A few white-tailed deer winter along the lower elevations of Libby Creek, but the vast majority leave the mine area to winter along Miller Creek and east of U.S. 2 (Figure 3-8).

Mule deer. Mule deer are abundant throughout the project area where they can be found in all habitat types. Although their range greatly overlaps white-tailed deer, they tend to be found at higher elevations and in more open habitat. Mule deer diets are dominated by forbs and browse throughout the year, with forbs preferred when available. Forbs dominate the diet in spring and summer, with use of browse increasing during the fall and winter (Wallmo and Regelin, 1981).

Mule deer use the project area primarily in summer, spring and fall. They winter on Big Hoodoo Mountain, along Miller Creek, and to the east of U.S. 2 (Figure 3-8). There is also some seasonal transitional range along Little Cherry Creek and Bear Creek.

Elk. Elk are an MIS. They are perhaps the least abundant ungulate in the project area, where they use all the drainages. Generally, elk use timbered areas for cover and open areas for feeding. Forested areas also present opportunities for elk foraging in the understory. Elk are adaptable and eat a wide variety of plant materials, but prefer to eat grasses when available. During summer months, forbs are also an important component of elk diet. During the winter, browse can be a main dietary component, especially if grasses are unavailable (Nelson and Leege, 1982).

Elk distribution in the project area appears to be spotty, but during spring, summer and fall, most of the project area may be used at some time. More activity is found at higher elevations. There is probably a traditional calving area on Big Hoodoo Mountain; other suitable calving habitat occurs in the upper drainages of West Fisher, Libby, Ramsey and Poorman creeks. During mild winters, elk winter on Big Hoodoo Mountain, while they move to Miller Creek and east of U.S. 2 during more severe winters (Figure 3-8). No elk were observed on Big Hoodoo Mountain during the "normal" winter of 1988/1989. Elk avoid hunters by seeking out areas of rough terrain, dense forests, and low road densities. KNF and MDFWP have identified these "security areas" in the Miller Creek headwaters and around Teeters Peak (Figure 3-8).

Mountain lion. Mountain lions are probably common in the mine area, although little is known about their distribution. The mine area is within an area with some of the highest lion densities in

Montana (Western Resource Development Corp., 1989d). Signs of mountain lions were observed along Poorman Creek and Bear Creek. One lion moved from the Poorman Creek drainage into Libby Creek, and another from Bear Creek to Big Hoodoo Mountain. Their seasonal movement patterns probably follow those of deer, which are their main food source.

Upland game birds. Two upland game bird species, ruffed grouse and blue grouse, were observed during the baseline surveys. A third species, spruce grouse, is also reported to be present (A. Bratkovich, District Biologist, KNF, pers. comm., July 24, 1989). Ruffed grouse concentrate in riparian habitat and are found in all habitat types except clearcuts. Blue grouse are observed in spruce-fir forests. Spruce grouse habitat requirements are similar to blue grouse.

Waterfowl and shorebirds. Suitable habitat for waterfowl and shorebirds occurs on Howard Lake, Libby, Ramsey, and Little Cherry creeks. Howard Lake is the most heavily used, providing a resting area for migrating waterfowl. Up to 300 geese and 300 ducks have been counted on Howard Lake; however, specific flight paths are not evident. Mallard nesting exists on Howard Lake, Libby Creek and at a pond just west of the Little Cherry Creek loop road. Spotted sandpipers are known to breed in habitat found along Libby Creek. Evidence of the presence of harlequin duck, a sensitive species, was observed along Ramsey Creek during baseline study.

Common sandpiper, killdeer, great blue heron, common goldeye, common merganser, and blue-winged teal are other species reported in the project area.

Raptors. Ten species of raptors were observed during the baseline surveys. American kestrels are confirmed nesters in the mine area. Observations indicate red-tailed hawk, northern goshawk and great horned owl probably nest there too. Sharp-shinned hawk, Cooper's hawk, northern pygmy owl, and barred owl may nest in the area. Osprey, golden eagle and great gray owl occur in the project area, but there is no indication these species nest in areas affected by mine facilities.

Other wildlife. Ninety-four breeding bird species other than raptors were identified in the mine study area during the 1988 breeding bird surveys. Ten other bird species were observed during the breeding season, but not during breeding bird plot counts. Bird densities are greatest in riparian habitat followed by spruce-fir, shrubfield, mixed conifer, western hemlock, and clearcut habitats.

Pileated woodpeckers are an MIS. They were the second most common woodpecker observed during the baseline studies using all timbered habitat types except riparian. Although breeding was not confirmed, there were strong suggestions it occurred in the project area during 1988. Breeding has been confirmed elsewhere on the KNF (Western Resource and Development, 1989d).

Eleven species of small mammals were trapped on small mammal plots during 1988. Total small mammal abundance, as indicated by trapping, is greatest in the shrubfield habitat followed by spruce-fir, mixed conifer, clearcut, western hemlock, and riparian habitats.

A number of other mammal species not sampled quantitatively are also present in the project area. These include snowshoe hare, beaver, porcupine, weasels, coyote, pine marten, mink, and bobcat .

Species of Special Concern

The baseline report lists forty-three species of special concern which potentially occur in the project area (Table 3-17). Four of these species (gray wolf, woodland caribou, bald eagle and peregrine falcon), are listed as endangered; the grizzly bear is listed as threatened by the FWS. Two others, wolverine and lynx, are considered candidate species which may be suitable for listing, but sufficient data are lacking to do so at the present time. The gray wolf, bald eagle, peregrine falcon and grizzly bear are also MISs.

Table 3-17. Wildlife species of special concern in the project area.

Class Species	Status USFWS[a]	State[b]	KNF[c]	MNHP[d]	Presence[e]
Birds					
Common loon			S	S3	
Harlequin duck		S	S	S2	
Osprey		S			P
Bald eagle	LE	S	E	S3	P
Cooper's hawk		S			
Northern goshawk		S			P
Golden eagle		S			P
Merlin		S			
Peregrine falcon	LE	S	E	S1	
Prairie falcon		S			
Upland sandpiper		S			
Long-billed curlew		S		S4	
Northern pygmy owl		S			P
Burrowing owl		S		S3	
Barred owl		S			P
Great gray owl		S		S3	P
Long-eared owl		S			
Boreal owl			S	S3	
Northern saw-whet owl		S			
Pileated woodpecker		S			P
Olive-sided flycatcher		S			P
Western bluebird		S			P
Bobolink		S			
Brewer's sparrow		S			
Reptiles					
Northern alligator lizard				S3	
Amphibians					
Pacific giant salamander		S		S1	
Rough-skinned newt		S		S1	
Coeur d'Alene salamander	3C	S	S	S1	
Tailed frog		S		S3	P
Wood frog		S		SU	

Source: Western Resource Development Corp. 1989d.
Footnotes on following page

Table 3-17. Wildlife species of special concern in the project area (cont'd).

Class Species	Status USFWS[a]	State[b]	KNF[c]	MNHP[d]	Presence[e]
Mammals					
Vagrant shrew					P
Pygmy shrew		S			
Long-legged myotis		S			
California myotis		S		S2	
Townsend's big-eared bat		S	S	S2	
Hoary marmot		S			P
Northern bog lemming		S		S1	
Gray wolf	LE	S	E	S1	
Grizzly bear	LT	S	T	S3	P
Fisher				S2	A
Wolverine	C2	S		S4	P
Canada lynx	C2	S		S4	H
Woodland caribou	LE	S	S	SH	

Source: Western Resource Development Corp. 1989d.

[a]Federal status of species as defined by the U.S. Fish and Wildlife Service:

LE—Listed Endangered

LT—Listed Threatened

C1—Notice of review, Category 1 (substantial biological information on file to support the appropriateness of proposing to list as endangered or threatened).

C2—Notice of review, Category 2 (current information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial biological information is not on file to support an immediate ruling).

3C—Taxa that have proven to be more abundant or widespread than was previously believed, and/or those that are not subject to any identifiable threat.

[b]State status of species identified as being of "special interest or concern" for Lincoln and/or Sanders counties and/or the Libby latilong block by Flath (1984).

[c]Kootenai National Forest species status identified as endangered (E), threatened (T), or sensitive (S). (R. Summerfield, KNF Wildlife Biologist)

[d]State status of species identified during a February 1989 Montana Natural Heritage Program computer survey of the Montanore Project study area, including transmission line corridors. Codes are:

S1—Critically imperiled in Montana because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction from the state. (Critically endangered in state.)

S2—Imperiled in Montana because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction from the state. (Endangered in state.)

S3—Rare in Montana (on the order of 20+ occurrence). (Threatened in state.)

S4—Apparently secure in Montana.

S5—Demonstrably secure in Montana.

SU—Possibly in peril in Montana, but status uncertain more information needed

SH—Historically known in Montana, may be rediscovered

[e]Presence

P—Presence confirmed in project study during the present 1988/89 study.

A—Present adjacent to the project study area during the 1988/89 baseline study.

H—Species documented on the project study area in the last 10 years.

The U.S. Fish and Wildlife Service has determined that of the listed species, only the peregrine falcon, bald eagle and grizzly bear, may occur in the project area. Additionally, there is no evidence of occurrence of either the gray wolf or woodland caribou in the eastern Cabinet Mountains, so they are unlikely to be affected by project activities.

Bald eagle. Bald eagles are most abundant in the vicinity of Libby during fall and spring migrations (November and February), and are more abundant in winter than summer. Bald eagles migrate along Libby Creek and the Fisher River. The KNF has identified the Fisher River as a flight corridor. During winter, they are found along the Kootenai and Clark Fork rivers, at Flathead Lake and at Lake Koocanusa. Some bald eagles winter on Libby Creek upstream from U.S. 2. No suitable nesting habitat occurs in the mine area, and no bald eagles were observed during the baseline surveys. Some may hunt over big game winter ranges in the project area, although none were observed during the baseline surveys.

Grizzly bear. Grizzly bears occur in the Cabinet Mountains and at least one has used the upper portions of Libby and Miller Creeks in recent years. The ranges of a few grizzly bears probably overlap the project area. An ongoing grizzly bear study conducted by Montana Department of Fish, Wildlife, and Parks indicates that up to 15 grizzly bears with an average home range size of 113 square miles inhabit the Cabinet-Yaak ecosystem. The study radio-collared three grizzly bears and the home range of each overlapped the Libby Creek, Ramsey Creek,and upper east fork of Rock Creek drainages. Historical records indicate the upper drainages of West Fisher Creek, and nearby upper Libby Creek, Ramsey Creek, and East Fork of Rock Creek are a grizzly bear concentration area. All transmission line routes cross grizzly bear habitat identified by the KNF. The least amount of habitat crossed is four miles while the most crossed is six miles.

The Cabinet-Yaak ecosystem is one of three ecosystems targeted for grizzly bear introductions by the grizzly bear recovery plan, which calls for an eventual population of 70 grizzly bears in the ecosystem. The first introduction of two young female grizzlies has been postponed from August, 1989 to August, 1990.

Grizzly bear food habits and habitat are similar to black bears. Grizzly bears are more likely than black bears to avoid areas within 550 yards of open roads. The Montana Department of Fish, Wildlife, and Parks study indicated grasses and sedges dominated their diet in May, June and October. Forbs were dominant in July. In August the diet shifted to shrubs, primarily huckleberry. Berries are important food for preparing the bears for denning.

Libby Creek, Ramsey Creek and the upper elevations of the East Fork of Rock Creek all have sufficient forage to be important fall feeding areas; Libby Creek has plentiful spring forage.

Boreal owl. Preferred habitat for boreal owl is spruce-fir forest above 5,000 feet with some nesting occurring in lower elevation spruce-fir and western hemlock habitat. Nesting has been confirmed on the KNF and suitable habitat for the boreal owl is present in the Libby Creek, Ramsey Creek and Poorman Creek drainages. Results of a survey performed in 1989 to determine the presence of the boreal owl in these drainages were inconclusive.

Peregrine falcon. Peregrine falcons occur in the project area and its vicinity as rare migrants (Western Resource Development Corp., 1989d). None were identified during baseline data collection. Suitable nesting habitat is scarce.

Wolverine. Wolverines are a candidate species for listing as threatened or endangered, if sufficient evidence is found to justify the action. They are apparently secure in Montana and are present in Lincoln County. Wolverine densities have been increasing in northwestern Montana since about 1940 (Western Resources Development Corp., 1989d).

One wolverine track was found in the West Fork of Rock Creek during the baseline study.

Canada lynx. Canada lynx also is a candidate species for the endangered list. The project area is within a portion of Montana which has some of the highest lynx numbers in the state. Canada lynx apparently are not abundant in the project area. No Canada lynx were observed during the baseline studies. Snowshoe hares are a very important component of lynx diets, but lynx will also eat small mammals and birds. In western Montana, they are usually found in dense, high elevation, coniferous forests.

Other sensitive species. There are neither gray wolves nor woodland caribou in the eastern Cabinet Mountains (Western Resource Development Corp., 1989d).

Species listed as sensitive by the KNF in the transmission line corridor include northern northern goshawk, barred owl, pileated woodpecker, and tailed frog. The bird species depend on old growth timber stands. The tailed frog is found in Libby and Ramsey creeks. Miller Creek was not searched for tailed frogs, but is suitable habitat.

SOILS

Four geomorphic processes, colluvial (movement downhill as a result of gravity), fluvial (movement by flowing water), lacustrine (movement or deposition in lakes) and glacial (movement by glaciers) have influenced soils development in the project area. Soils forming in glacial or colluvial material are typically high in rock fragments. Soils forming in lacustrine sediments, deposited along the Fisher River, Miller Creek, West Fisher Creek and Libby Creek, are typically higher in silts and clays with few rock fragments. Blanketing much of the project area soils is a thin mantle of fine volcanic ash, derived from a volcano that is now Crater Lake in Oregon.

Soil Types

In the project area, soils can be placed into four general groups, based on the type of parent material in which they formed. The four groups, described in the following sections, are colluvial/glacial, colluvial/residual, alluvial/lacustrine, and rock outcrop/residual.

Colluvial/glacial. The colluvial/glacial soils occur on moderately to steeply sloping, glaciated valley sideslopes primarily in the tailings impoundment area and along the access road. The soils are deep, have a high content of rock fragments, and vary in texture. Organic matter content is high (two to five percent) in the surface layers and is typically less than one percent in subsoil layers. Soil salinity levels are characteristically low.

A typical soil profile of this group consists of a thin (2 to 14 inches) surface layer overlying subsoil layers varying in texture and in rock fragments. Surface soils are silt loams, having a coarse to moderately fine texture. The subsoils range widely in texture, from coarse (15 percent clay) to fine (60 percent clay), depending on the parent material. Rock fragment content is low in the ash-influenced surface layer and generally increases with depth. Acidity is also quite variable, ranging in pH from 4.7 to 7.5. More acidic soil pHs (5 to 6) are typical.

Soils on steep mountain sideslopes and avalanche chutes near the plant site are also in the colluvial/glacial soils group. These soils occur primarily along Ramsey Creek near the proposed plant site location and along Libby Creek below the Libby Creek adit site. These soils have a thin, ash-influenced layer typically with less than 15 percent rock fragments. Below the surface layer are coarse-textured layers with more than 35 percent rock fragments. These soils are acid throughout their profiles, with pH values typically ranging between 5 and 6.

Mixed coniferous forest and clearcuts are the primary vegetation types found on the colluvial/glacial soils

group. A shrub-dominated community, comprised primarily of huckleberry and thimbleberry, occurs on the soils found in the avalanche chutes.

Colluvial/residual. The colluvial/residual soils group is found on steep slopes and bedrock-controlled ridges in the tailings impoundment and percolation pond areas, and along the transmission line route. On steeper slopes, colluvial processes have affected the development of these soils. As with most soils in the mine area, the soils in the residual soils group have a thin ash-influenced layer. Rock fragment content in the surface layer is generally low and very high in the subsoil layer. Values for pH are generally acidic, ranging between 5 and 6. This soil group supports a coniferous forest vegetation type.

Alluvial/lacustrine. Soils in this group have formed in alluvium, lacustrine deposits and glacial outwash. Narrow areas of alluvial deposits occur throughout the project area. Lacustrine deposits occur along the Fisher River, Miller Creek, Schrieber Creek and Little Cherry Creek. Typical surface textures for soils in this group are silt loam, and subsoil textures vary from coarse to fine. Rock fragment content is low in soils formed in the lacustrine deposits, and variable in the alluvial deposits. These soils are acidic throughout their profiles, with pH values typically ranging between 5 and 6.

Soils forming in alluvial deposits occur along all the project area streams. Depth to water is variable, with some soils saturated throughout most of the year. Soil texture and rock fragment content are variable. The soils are slightly acid, with pH values ranging between 6 and 7. This soil group supports a coniferous forest vegetation type.

Rock outcrop/residual. This group primarily consists of areas with exposed bedrock and little soil development. These areas are typically on ridges and glaciated valley sideslopes at higher elevations near the plant site and along the transmission line corridor. Where soils exist, they are thin (<20 inches) and high in rock fragments. This group supports a variety of alpine and subalpine vegetation.

Suitability for Reclamation

The surface layers of the mine area soils are generally suitable for topsoil salvage and replacement. Decisions regarding soil suitability and the necessity for soil salvage along the transmission line will be made in the field after road locations have been finalized. Organic matter levels in surface soils are generally moderate to high, and pH values range between 4.9 and 6.6. Because of the ash influence, the surface layers are typically coarse textured and have a high water holding capacity relative to the coarse soil texture. Surface soils typically have less than 15 percent rock fragments. Subsoil layers are more variable in texture, pH, and rock fragment content.

The primary limitation to soil suitability for reclamation is rock fragment content (Table 3-18). Soils with more than 50 percent rock fragments are generally considered unsuitable. Some soils in the tailings impoundment area with rock fragment content up to 60 percent are proposed for salvage. A high water table would preclude salvage of some soils.

VEGETATION

The project area vegetation is characteristic of the Northern Rockies. Most of the project area is covered by a coniferous forest comprised of seven dominant tree species. Logging has produced clearcuts on nearly a quarter the mine area. Coniferous forest and clearcuts comprise nearly 90 percent of the mine area. Shrub-dominated communities occur on steeper slopes and at higher elevations. Communities adapted to more moist sites, dominated by Engelmann spruce, occur along the major streams.

Vegetation of the transmission line corridors resembles that of the mine area. Proportions of vegetation types crossed vary little among the three routes: 67 to 78 percent coniferous forest; 17 to 29 percent clearcut, and 4 percent riparian.

Table 3-18. Soil suitability depths for mine area soils.

——Soil—— group type	Suitable depth (in.)	Limitation
Colluvial/residual		
Andic Dystrochrepts, moderately deep	11	Rock fragments
Andic Dystrochrepts, deep	9	Rock fragments
Colluvial/glacial		
Andic Cryochrepts	29	Rock fragments
Andic Cryochrepts	20	Rock fragments
Typic Cryochrepts/ Cryumbrepts	0	Rock fragments; surficial boulders
Typic Cryorthents	0	Rock fragments
Typic Glossoboralfs	33	Rock fragments
Typic Paleboralfs	24	Rock fragments
Alluvial/lacustrine		
Andic Dystrochrepts	65	Rock fragments
Andic Dystrochrepts	9	Rock fragments
Andic Dystrochrepts	9	Rock fragments; pH, texture
Typic Humaquepts	15	High water table
Cumulic Humaquepts	9	High water table

Source: Noranda Minerals Corp. 1989a. V. 1, pp. I-81*ff*.

Vegetation Types

Six vegetation types have been identified in the project area—Coniferous Forest, Clearcut, Shrubfields, Wetlands, Riparian, and Agricultural Land.

Coniferous forest. This type is the largest vegetation type in the project area, comprising about 50 percent of the area. Timber harvesting occurs in this vegetation type. Six predominant tree species occur in the type—western red cedar, western larch, western hemlock, grand fir, Engelmann spruce, and lodgepole pine. Western red cedar and western hemlock are the dominant tree species in the transmission line corridor.

The KNF has identified scattered stands of coniferous forest in the project area as "old growth." It manages these stands to maintain forest diversity and for wildlife habitat. Dense canopy cover (100 percent or more), large diameter trees, and sparse shrub and forb growth typify old growth stands. All transmission line alternatives may cross areas of old growth timber.

With 129 identified species, this is the most diverse vegetation type in the project area. Western hemlock provides the highest cover and grand fir has the highest density in the mine area. Out of a 32.1 thousand board feet per acre total, Western hemlock provides nearly half the timber volume (15.7 thousand board feet per acre). Grand fir and Douglas fir provide about ten percent of the total board volume. Black cottonwood has the highest average diameter of 34 inches. Most trees are considerably smaller; western larch has a diameter of nearly 11 inches and Douglas-fir has an average diameter of nearly 9 inches.

A variety of shrubs and forbs occur in this type, with Rocky Mountain maple, Pacific yew, sitka alder, and huckleberry being common shrubs, and tiarella, queencup beadlily, heartleaf arnica, and western goldthread common forbs. Nineteen grasses are found in the type, but provide little cover. Shrub densities are high, at over 6,600 stems per acre. The most common grasses include reed mannagrass occurring on wetter sites, and pinegrass in drier areas.

Clearcut. Clearcut areas are scattered throughout the project area; most logging occurred between 10 and 20 years ago. Clearcuts have a species diversity similar to the Coniferous Forest type. Western red cedar, western larch, Douglas-fir, Engelmann spruce, and lodgepole pine are the most abundant tree species in the type. Total tree density is 916 trees per acre. Engelmann spruce, black cottonwood, and western white pine have the highest

reproduction rates; total tree reproduction rate is about 2,200 trees per acre. Most trees are small with an average diameter for most species less than two inches.

Shrubs are abundant in the Clearcut type, taking advantage of the more open canopy. Over 15,000 stems per acre occur in this type, and shrubs provide about 25 percent of the relative cover. Common shrubs include white spirea, pachistima, Sitka alder, huckleberry, and snowberry.

Grasses provide 17 percent and forbs provide 24 percent of the cover in clearcut and coniferous forest areas. Baseline studies identified 23 perennial grasses and 51 perennial forbs. Grasses include pinegrass, northwest sedge, western fescue, and purple reedgrass; dominant forbs are Virginia strawberry, fireweed, orange hawkweed, and beargrass.

Shrubfields. Shrubfields occur in steep avalanche chutes in the Libby Creek and Ramsey Creek areas. Comprising of 26 shrubs, the type is diverse and provides cover and food for big game species including the grizzly bear. Major shrub species are thimbleberry, huckleberry pachistima, red raspberry, and Sitka alder. Shrub density, at 17,600 stems per acre, is the highest of the six identified vegetation types in the study area. Trees invading on shrubfields include subalpine fir, aspen and grand fir.

Beargrass is the most abundant of the 26 perennial forbs present. Other common perennial forbs include green false hellebore, hooker fairybell, starry Solomon's seal, and cow parsnip. Grasses provide about 10 percent of the relative cover, nearly half of which is bluejoint reedgrass.

Wetlands. Wetlands occur along drainages in the tailings impoundment area and the transmission line corridors. This type comprises about five acres in the tailings impoundment area. Species tolerant of high moisture conditions occurring in the type include beaked sedge, knot-sheath sedge, water sedge, and winged sedge. Shrubs around the periphery of the wetland areas include Douglas spirea and willows.

A small forested wetland, the largest in the mine area, is found along Ramsey Creek near the proposed plant site. This area was included in the Coniferous Forest type during vegetation mapping. The dominant tree species in this area is Engelmann spruce, with lesser amounts of western white pine, subalpine fir, and grand fir. Common understory species include common horsetail, bluejoint reedgrass, and arrowleaf groundsel.

Four wetlands fall within the transmission line corridors. The largest wetland, about 3/4 miles long, borders Libby Creek and is just downstream of the proposed creek crossings. Wetland vegetation surrounds Howard Lake and also occurs in a forest opening north of the lake. The fourth wetland runs along Miller Creek slightly south of where the North Miller Creek route diverges from the proposed route.

According to the vegetation baseline report, wetland areas were identified and mapped in accordance with the regulatory definition of a wetland found in the Clean Water Act. As discussed in Chapter 1, Noranda is required to obtain a "404 permit" from the Army Corps of Engineers prior to disturbing any wetland areas.

Riparian. The Fisher River is bordered by a mixture of conifers and mature cottonwoods. The cottonwoods grow in scattered clumps, reaching diameters of over 20 inches and heights of 60 feet. Scattered old cottonwoods have grown to 80 feet tall and 48 inches in diameter along upper Libby Creek. Further downstream, flooding has created conditions that favor dense stands of saplings and pole-sized cottonwoods. Riparian shrubs include Sitka alder and snowberry. All transmission line routes cross the Fisher River's riparian zone; the two Miller Creek routes also contact Miller Creek riparian zone.

Agricultural Land. At lower elevations along the eastern edge of the project area, there are several scattered farms along U.S. 2. All cultivated farmlands are along the highway. The lands used for agriculture range in size from 10 acres to almost 60 acres.

Threatened, Endangered, or Sensitive Species

The FWS has not listed any threatened or endangered plant species for Montana under the Endangered Species Act. No sensitive plant species listed by the KNF are known to occur within the project area. The Montana Natural Heritage Program also has identified three species—woolgrass, yerba buena and Pacific blackberry—as imperiled in Montana. A small population of woolgrass occurs in the tailings impoundment area. Yerba buena and Pacific blackberry were not identified in the project area.

Noxious Weeds

The District Weed Control Board of Lincoln County has identified noxious weeds occurring within its jurisdiction. Three species from this list—Canada thistle, St. Johnswort, and spotted knapweed—were identified in the project area. Spotted knapweed is found along the Fisher River, adjacent to U.S. 2, and most roads in the project area. It reaches highest densities where low soil moisture or road maintenance prevents the establishment of competing plants. Knapweed is thought to affect big game animals by reducing available forage. Canada thistle occurs along roadsides and rapidly invades clearcuts following logging. St. Johnswort, typically found along roadsides, is unpalatable to livestock and big game animals, and can adversely affect livestock.

LAND USE

Most lands in the project area are managed by the KNF. Private land occurs along Libby Creek (patented mining claims), Miller Creek (forest industry and private), Fisher River (forest industry and private), and around Schrieber Lake (private). The KNF manages public land for multiple use benefits, including wood products, recreation, range, wildlife, mineral development and wilderness. Forest industry land is primarily managed for wood products, and private lands are managed to satisfy individual landowner objectives.

The National Forest lands of the Libby District provide approximately 25 million board feet (mmbf) of timber annually. There are three active Forest Service timber sales in the project area: Hoodoo (7.8 mmbf), Midas Creek (8.2 mmbf), and Horse Cable in Miller Creek (2.0 mmbf). Timber harvest activity also occurs on forest industry lands, providing about 115 million board feet annually (B. Caldwell, Supervisor, Libby Field Office, DSL, pers. comm.). This harvest level is expected to decline within 10 years.

Logging has taken place along Libby Creek adjacent to the private land since the late 1960s. Timber was harvested from upper Libby Creek and Ramsey Creek following the Libby Creek Road extension in the mid-1970s, resulting in a number of clearcut areas within the project area. Logging continues in the area, with new harvests in lower Ramsey Creek, upper Midas Creek, and much of Miller Creek. Champion International has clearcut harvested several tracts of private land on lower Miller Creek and along Fisher River.

There is one livestock grazing allotment in the project area near the Libby Creek and Midas Creek confluence. The permit allows 30 head of livestock to be grazed from May 16 to October 16.

A small amount of mineral activity occurs in the project area. The activity includes small placer operations on Libby and Big Cherry creeks, small lode activities at the headwaters of the West Fisher, and lode activities in the Prospect Hill area by Libby. Between 10 and 20 operators do some form of mineral work along the east face of the Cabinet Mountains each year.

The project area is used extensively for recreation (discussed in the Recreation section). A few private residences are located near U.S. 2, particularly near the Libby Creek Road, the Bear Creek Road, the Fisher River, and Schrieber Lake.

KOOTENAI NATIONAL FOREST MANAGEMENT

Management direction for the Kootenai National Forest is given in the Forest Plan (Kootenai National Forest, 1987). This document provides forest-wide management goals, objectives and standards, and goals and standards for sub-units of the KNF referred to as Management Areas.

Forest-wide Goals, Objectives, and Standards

Goals. Goals provide information on the long-range management intent. The objectives and standards of both the forest as a whole and individual Management Areas must support the goals. All activities conducted on the KNF must contribute to the realization of the goals. The goal for mineral development, discussed under Goal #11 is—"encourage responsible development of mineral resources in a manner that recognizes national and local needs and provides for economically and environmentally sound exploration, extraction, and reclamation.

The Forest Plan also establishes a goal of providing a sustained yield of timber volume responsive to market demands and supportive of a stable base of economic growth in the dependent geographic area. The Plan also establishes a goal of minimizing timber losses from the mountain pine beetle by harvesting the maximum amount of high risk lodgepole pine that is marketable.

Goals for the wildlife resource include (1) maintaining and enhancing sufficient habitat to facilitate recovery of threatened and endangered species; (2) maintaining diverse age classes of vegetation to support viable populations of existing vertebrate species, including old growth dependent species; (3) managing for sufficient snags (dead standing trees) to maintain viable populations of snag-dependent species; and (4) maintaining big game and fisheries habitat.

For water quality, the Forest Plan establishes a goal of meeting or exceeding State water quality standards. To achieve this goal, forest-wide objectives for water quality require application of practicable mitigation measures, including those identified in the Soil and Water Conservation Handbook.

Objectives. Mineral exploration and development may occur on nearly all areas of the KNF; areas withdrawn from future mineral entry include the Cabinet Mountains Wilderness and developed recreation sites. Noranda established a valid existing claim for mineral resources inside the wilderness prior to withdrawal. The objective concerning minerals requires consideration of other resources during mineral exploration and development.

Objectives for facility corridors, such as a transmission line corridor, are discussed under Corridors in the Forest Plan. The objectives establish corridor exclusion, avoidance, and window areas to assist in corridor siting. Criteria for these areas are outline in Appendix 15, Corridor Criteria, of the Forest Plan.

Goals and objectives for cultural resources, recreation, visual resources, air quality, road management, and riparian areas have also been established and are described in the Forest Plan.

Standards. The minerals standard requires the KNF to "recognize the value and importance of the mineral resource in management activities." Road access for mineral development "will be allowed if it is the next logical step in the development of the mineral resource," subject to the restriction of various laws, such as the Wilderness Act and the Endangered Species Act. Plans of Operations for mineral development must include "reasonable and justified" requirements designed to minimize environmental impacts. The KNF is required to provide guidance to the mineral industry to assist in developing environmentally sound mining and reclamation plans.

Management Area Goals and Standards

The Forest Plan also includes goals and standards for 23 Management Areas (MAs), which are geographic

sub-units of the KNF with different management emphases. The combination of these Management Area emphases are intended to achieve the forest-wide goals and objectives.

Figure 3-9 shows the distribution of Management Areas within the proposed project area. Brief descriptions of the MAs which occur near the project area are given in the following sections. The standards are summarized in Table 3-19.

For all MAs discussed in the following sections, the standard for minerals refer to the forest-wide standards described in the previous section. In all MAs, soil and water conservations practices must be implemented for all developmental activities

Semi-primitive Non-motorized Recreation (MA 2). This MA offers roadless recreation opportunities. The goal of this MA is to provide for the protection and enhancement of areas for roadless recreation use and to provide for wildlife management where specific wildlife values are high. In some areas, this MA provides habitat that will contribute to grizzly bear recovery. Some roads are currently open to some form of motorized recreational use, including snowmobiles. Roads may be justified for mineral activities. Trails are normally closed to all motorized vehicles. This MA is classified as a corridor avoidance area.

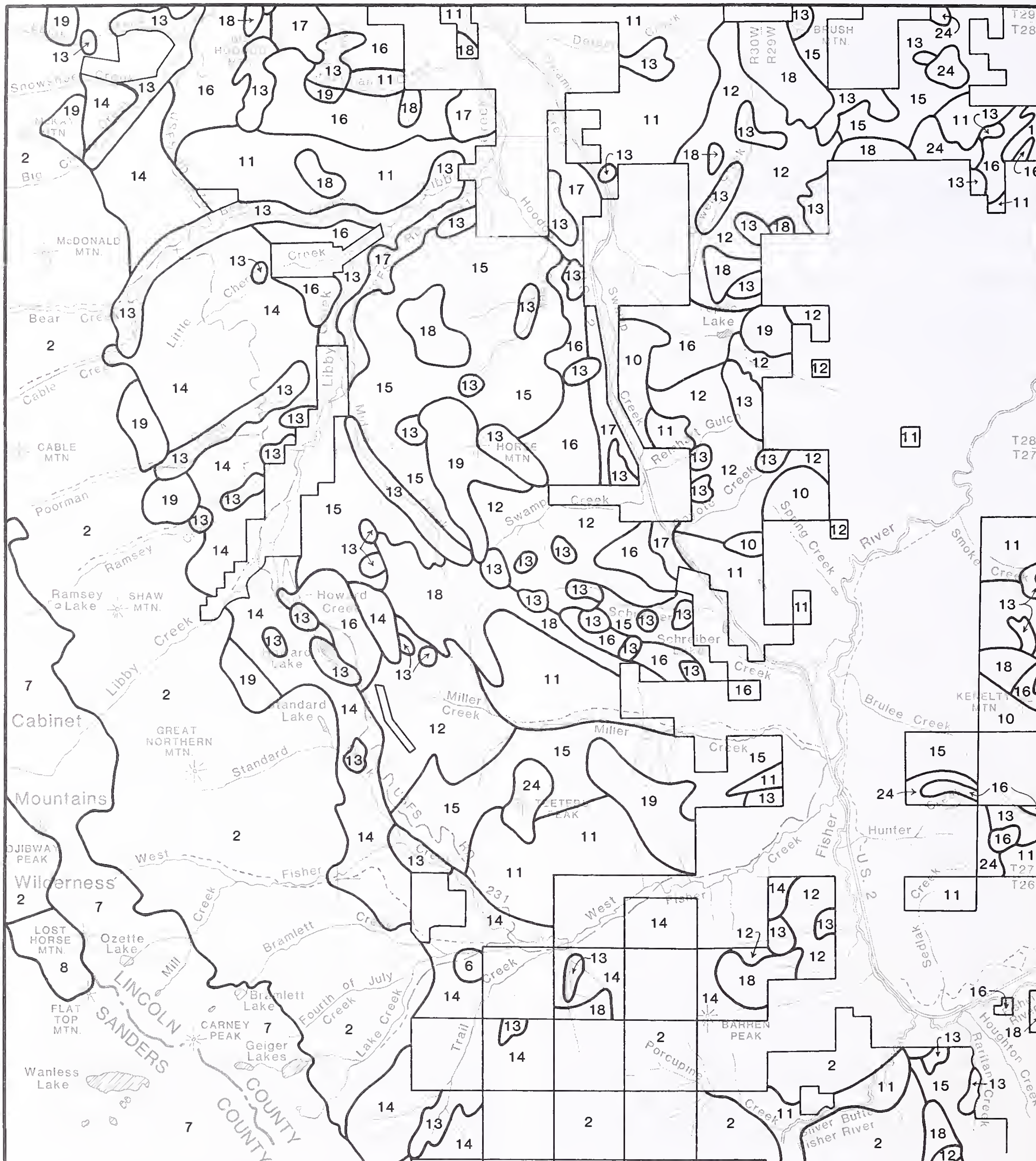
Developed Recreation Sites. This MA includes developed campgrounds, picnic areas, boat ramps, and other developed recreation sites. Areas are usually associated with water features such as lakes, reservoirs, and streams. The management goal is to provide safe and sanitary developed recreation in a setting that is pleasant and visually attractive. Seasonal use restrictions may also be applied if appropriate in areas to avoid wildlife conflicts. This MA is usually withdrawn from mineral development, and is classified as a corridor avoidance area. (Forest Plan, pp. III-17 to III-20.)

Existing Wilderness (MA 7). This MA is composed entirely of the Cabinet Mountains Wilderness. The wilderness is managed in accordance with the Wilderness Act of 1964. Goals include maintaining natural conditions, providing opportunity for solitude and primitive forms of recreation, and encouraging grizzly bear recovery. Habitat for other wildlife species is preserved, although habitat enhancement projects are not permitted. Valid mineral rights are recognized and these rights are managed in accordance with the Wilderness Act and other applicable laws and regulations. Road construction is not permitted, except to provide reasonable access to valid mineral rights. The MA is classified as a corridor exclusion area. (Forest Plan, pp. III-21 to III-25.)

Big Game Winter Range/Timber (MA 11). The Forest Plan goal for this MA is maintaining or enhancing the winter range habitat effectiveness for big game species while also producing a programmed yield of timber, and maintaining the viewing resource in areas of high visual significance. The goals and standards concentrate on protection of important wintering areas, and providing optimum habitat for elk, mule deer, whitetail deer, moose, sheep and goats for winter survival. Corridors are permitted. (Forest Plan, pp. III-43 to III-47.)

Big Game Summer Range/Timber (MA 12). This MA emphasizes maintenance or enhancement of summer and fall big game habitat while producing a programmed yield of timber. The goals and standards focus on providing big game habitat diversity for black and grizzly bear, elk, moose, mule deer and whitetail deer. Timber production will be maintained through cultural treatments and regeneration harvest designed to reduce the frequency of entries. Facilities which require frequent maintenance or occupancy are normally not allowed. This MA is a corridor avoidance area in areas important to grizzly bear use. (Forest Plan, pp. III-48 to III-50.)

Designated Old Growth Timber (MA 13). The Forest Plan goal for this MA is to provide the special habitat necessary for old growth-dependent wildlife on a minimum of 10 percent of each major drainage,



Source: Kootenai National Forest. 1987

LEGEND

- 2 Semi-primitive Non-motorized Recreation (Unsuitable Timberland)
- 6 Developed Recreation Sites (Unsuitable Timberland)
- 7 Existing Wilderness (Unsuitable Timberland)
- 8 Recommended Wilderness (Unsuitable Timberland)
- 10 Big-Game Use (Unsuitable Timberland)
- 11 Big-Game Winter Range (Suitable Timberland)
- 12 Big-Game Summer Range (Suitable Timberland)
- 13 Designated Old-Growth Timber (Unsuitable Timberland)
- 14 Grizzly Habitat Management (Suitable Timberland)
- 15 Timber Production (Suitable Timberland)
- 16 Timber with Viewing (Suitable Timberland)
- 17 Viewing with Timber (Suitable Timberland)
- 18 Regeneration Problem Areas (Unsuitable Timberland)
- 19 Steep Lands (Unsuitable Timberland)
- 24 Low Productivity Areas (Unsuitable Timberland)

Note: Areas Not Labeled Are Not KNF Lands

FIGURE 3-9.

KNF MANAGEMENT AREAS IN PROJECT AREA

NORTH

0 1 2

MILES

Table 3-19. Summary of relevant standards in selected Management Areas on the KNF.

Management Area	Locatable mineral development[†]	Powerline corridors	Road development	Motorized access	Logging	Lands & facility occupancy	Wildlife
Semi-primitive non-motorized recreation (2)	Forest-wide standards apply	Avoidance area	Generally prohibited; existing roads may be used for mineral development on a case-by-case basis	Closed, except for limited exceptions	Unsuitable	Frequently used facilities normally prohibited	Grizzly habitat
Developed recreation sites (6)	Restricted	Avoidance area	Restricted	Restricted	Unsuitable	Permitted	Provide habitat
Existing wilderness (7)	Prohibited except for valid rights	Exclusion	Prohibited, except for mineral development	Prohibited	Prohibited	Prohibited	Emphasize grizzly habitat
Big game winter range (11)	Forest-wide standards apply	Permitted	Allowed	Closed during winter	Suitable	Permitted with winter restrictions	Maintain openings for big game
Big game summer range (12)	Forest-wide standards apply	Avoidance area in grizzly habitats	Restricted	Roads generally closed	Suitable	Frequently used facilities normally prohibited	Big game and grizzly habitat
Designated old growth timber (13)	Forest-wide standards apply	Avoidance area	Restricted	Prohibited during summer/fall	Unsuitable	Restricted	Grizzly bear and old growth species habitat
Grizzly habitat (14)	Forest-wide standards apply	Avoidance area	Allowed, outside grizzly use times	Allowed, with restrictions	Suitable	Generally prohibited	Grizzly habitat
Timber production (15)	Forest-wide standards apply	Permitted	Allowed	Allowed	Suitable	Permitted	Provide habitat
Timber with viewing (16)	Forest-wide standards apply	Permitted	Allowed	Allowed	Suitable	Permitted	Provide habitat
Viewing with timber (17)	Forest-wide standards apply	Permitted	Allowed	Allowed	Suitable	Permitted	Provide habitat
Revegetation problem areas (18)	Forest-wide standards apply	Permitted	Very restricted	Allowed	Unsuitable	Permitted	Provide habitat
Steep lands (19)	Forest-wide standards apply	Avoidance area	Very restricted	Restricted	Unsuitable	Generally prohibited	Provide habitat

Source: Kootenai National Forest. 1987.
[†]The Montanore Project would be a "locatable mineral development"

and in units that represent the major habitat types and tree species of each drainage. The goals and standards emphasize providing diverse, high quality, year-round habitat for old growth-dependent wildlife (usually other than big game) by relying on natural processes of stand aging, decadence and eventual deterioration. This MA is classified as a corridor avoidance area. (Forest Plan, pp. III-54 to III-57.)

Grizzly Habitat (MA 14). This MA is designed to maintain or enhance grizzly bear habitat, reduce grizzly/human conflicts, assist in the recovery of the grizzly bear, realize a programmed level of timber production, and provide for the maintenance or enhancement of other wildlife, especially big game. Grizzly habitat components that are identified will be maintained or enhanced and key components such as wallows, wet meadows and bogs will be mapped and managed as riparian areas. This MA is classified as a corridor avoidance area. (Forest Plan, pp. III-58 to III-63.)

Timber Production (MA 15). The Forest Plan goal for this MA is to focus upon timber production using various standard silvicultural practices while providing for other resource values such as soil, air, water, wildlife, recreation and forage for domestic livestock. This MA has standards and guidelines for providing optimum timber production by ensuring full stocking through natural and artificial regeneration, and maintaining optimal volume growth through stocking control by thinning. Most roads are available for motorized recreation. Corridors are permitted. (Forest Plan, pp. III-64 to III-67.)

Timber with Viewing (MA 16). This MA is characterized by productive forest land that has moderate viewing sensitivity. There are no identified habitats for threatened or endangered species. The goals of this MA are to produce timber while providing for a pleasing view. Most roads are available for motorized recreation. Corridors are permitted. (Forest Plan, pp. III-69 to III-73.)

Viewing with Timber (MA 17). This MA emphasizes maintenance and enhancement of a natural-appearing landscape to provide a pleasing view, while producing a programmed volume of timber. The goals and standards focus on providing landscapes that are pleasing to the viewer, while producing a level of timber production that is compatible with visual resource protection. Roads are generally located so they are not visible from major travel corridors. Corridors are permitted. (Forest Plan, pp. III-74 to III-78.)

Regeneration Problem Areas (MA 18). This MA occurs on areas of slopes in excess of 40 percent where timber productivity is moderate to high. This MA is distinguished by the difficulty in establishing coniferous regeneration after timber harvest. The goals of this MA are to maintain existing vegetation until techniques and practices are available to ensure that timber can be harvested and the area regenerated within five years of harvest, and to maintain viable populations of existing native wildlife species. Because of the sensitivity of this MA, water quality and soil erosion will be monitored as part of any surface disturbance activity. Corridors are permitted. (Forest Plan, pp. III-79 to III-82.)

Steep Lands (MA 19). The Forest Plan goal for this MA is to ensure soil stability and water quality by maintaining the vegetation in a healthy condition and by minimizing surface disturbance. This MA has goals and standards that concentrate on the protection of soil and water quality by restrictions on harvest methods and other site disturbance activities. Both water quality and soil erosion must be monitored during these activities. The MA is classified as a corridor avoidance area. (Forest Plan, pp. III-83 to III-86.)

Riparian Areas. The Forest Plan goals and standards for these areas are intended to supplement the goals and standards that apply to the Management Areas where riparian areas are found. The goal for riparian area management is to manage the vegetation to protect soil and water resources and to provide high

quality water, habitat for indigenous fish and wildlife species (including grizzly bear), timber for harvest, water oriented recreation, and a pleasing view. Standards for these areas concentrate on meeting these goals by minimizing simultaneous openings on both sides of streams, encouraging recreational developments outside of riparian areas, following wildlife habitat guidelines during development of openings, restricting use of site-disturbing equipment. (Forest Plan, pp. II-28 to II-34.)

VISUAL RESOURCES

The KNF manages visual resources with a Visual Management System, which incorporates inventories of visual quality objectives (or classes), visual absorption capabilities and variety classes. Sensitivity levels are also established in this system for travel routes, trails and recreation areas. Visual quality objectives provide guidelines for the management of specific forest areas. There are five possible visual quality objectives, all of which occur in the project area. Modification and Maximum Modification were combined in Noranda's baseline study. They are—

- *Preservation*–managed for ecological changes only;
- *Retention*–managed for natural-appearing landscapes;
- *Partial retention*–managed for slightly modified landscapes;
- *Modification*–managed for modified landscapes; and
- *Maximum modification*–managed for greatly modified landscapes.

The proposed plant site, adits and associated access roads are in the Retention objective class, with the proposed tailing impoundment site in the Partial Retention class. Transmission line alternatives cross Retention, Partial Retention and Modification classes, as well as privately owned (non-federal) lands which are not included in the Visual Management System. The Cabinet Mountains Wilderness is in the Preservation class. Visual quality objectives in the project area are shown on Figure 3-10.

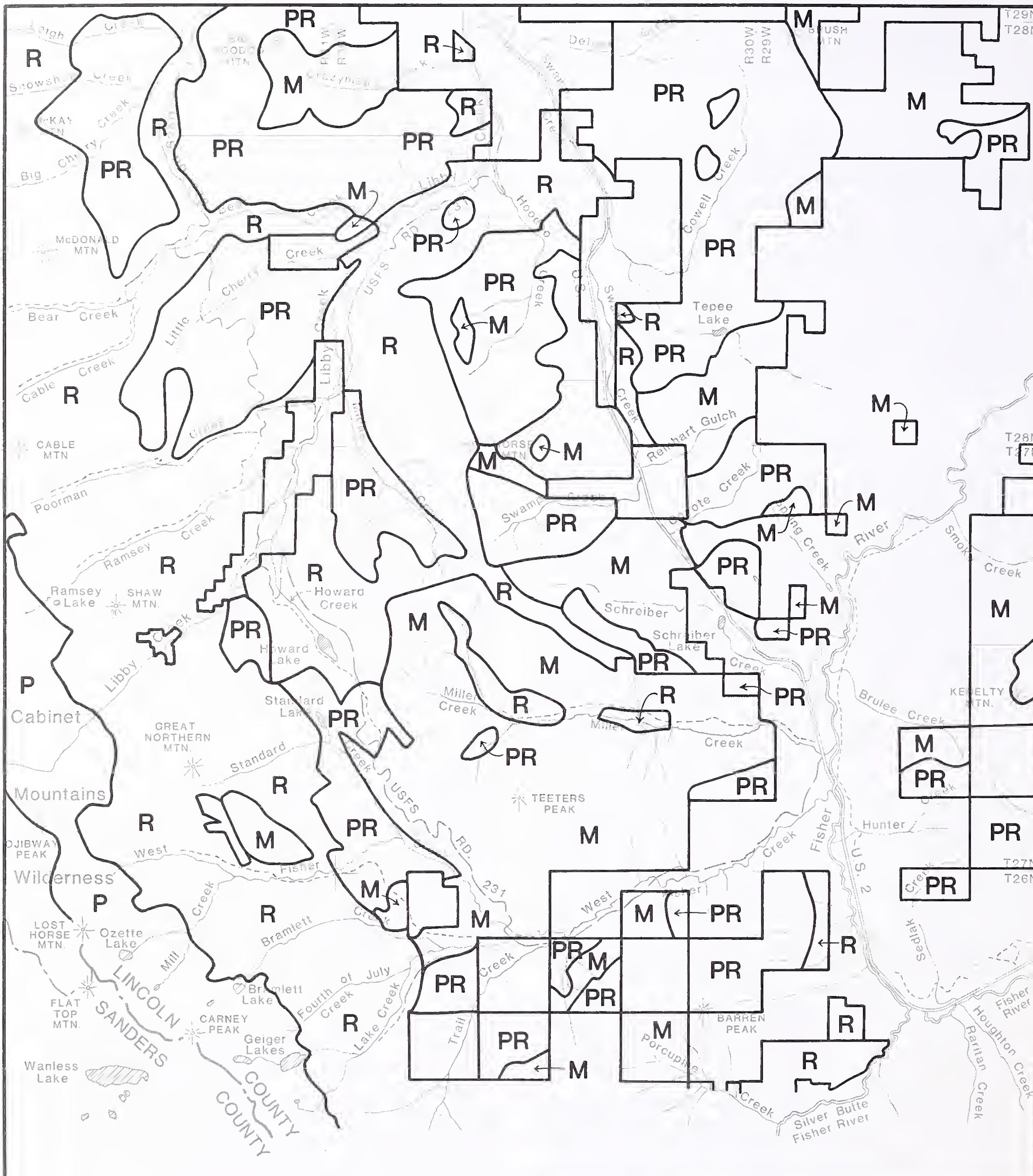
The landscape character of the project area is varied due to the topographic and vegetative diversity of the Cabinet Mountains. Visual absorption capability (VAC) is a measure of a landscape's ability to absorb visual change. Seven landscape types were identified in the project area as discussed in the following sections. Figure 3-11 shows the visual absorption capability values assigned to each of these landscape types.

Cabinet canyons. The plant site and the Libby Creek adit would be located in this landscape type. Cabinet canyons consist of very diverse topographic and vegetative features. Canyon floors are relatively long and narrow and the sides are steep and generally moderately to heavily forested with coniferous trees. Greater plant diversity and denser undergrowth occur near valley floors. This type has a high visual absorption capacity. Views in the mountain canyons are limited due to the vegetation canopy and view angle, which is acute from some areas and screened by landforms.

Cabinet shoulders. Cabinet shoulders consist of the truncated ridges extending eastward from the Cabinet Mountains. Topography consists primarily of steep side slopes without much landform diversity. Vegetation is generally dense coniferous forest. These shoulders are highly visible from a number of viewpoints and they have a low visual absorption capability. No mine-related disturbance on this landscape is proposed.

Intermountain valley floor. The proposed tailings impoundment would be located in the valley floor type. Topography consists of gentle slopes and vegetation is dense coniferous forest. This landscape has moderate-to-high ability to absorb visual change. Timber harvesting in the area has created a diversity of vegetation classes, colors and heights.

Public viewpoints are located on the KNF roads that criss-cross portions of the valley. Primary access to the mine area occurs on the existing Bear Creek and



Source: Woodward-Clyde Consultants, Inc. 1989c.

LEGEND

P	Preservation
R	Retention
PR	Partial Retention
M	Modification and Maximum Modification

Note: Areas Not Labeled Are Not KNF Lands

FIGURE 3-10.

NORTH

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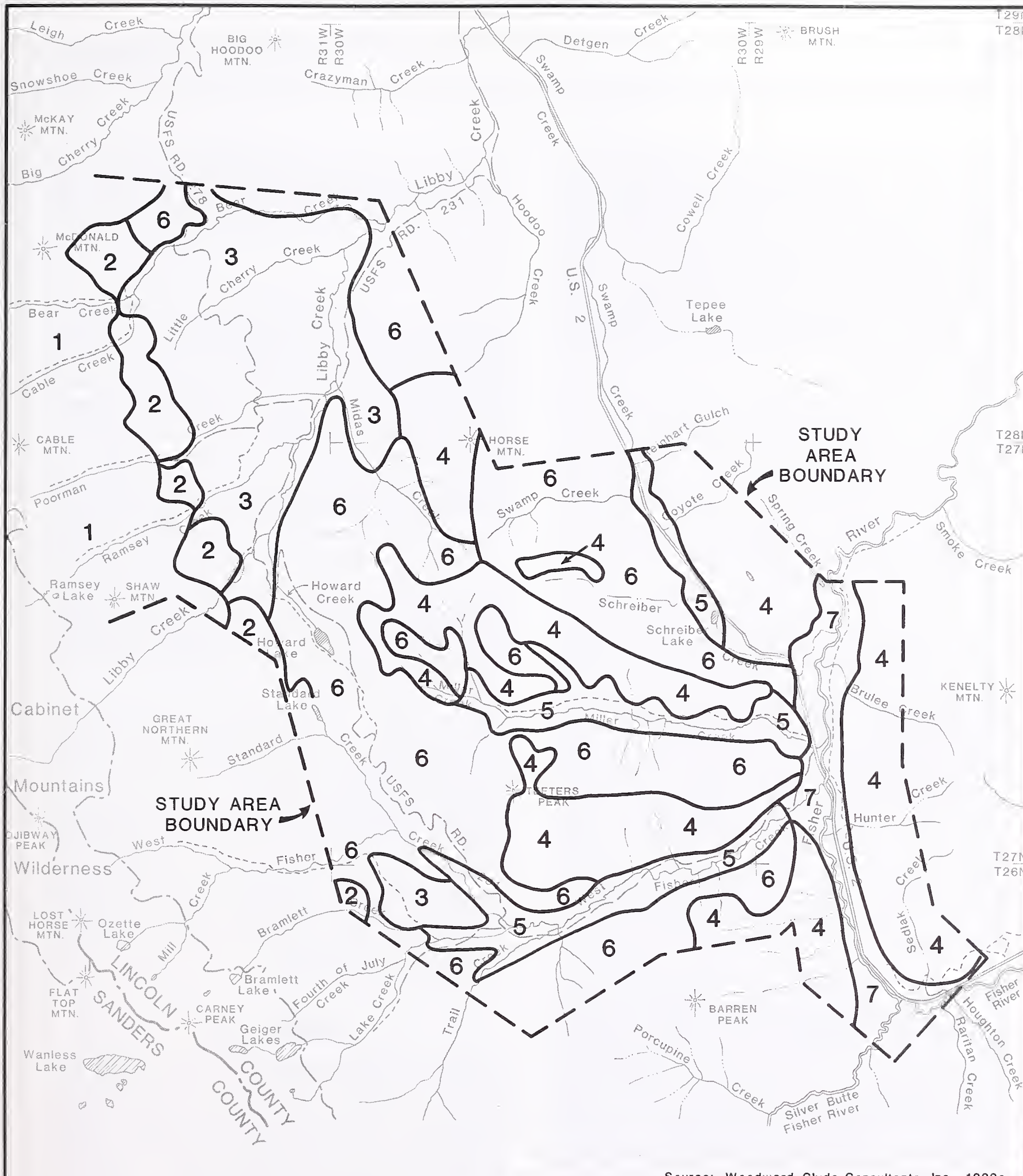
MILES

VISUAL QUALITY OBJECTIVES



VISUAL ABSORPTION CAPABILITY

HIGH	1. Cabinet Canyons 5. Riparian Valley
MODERATE TO HIGH	3. Intermountain Valley Floor 4. Open Mountain Faces 7. Valley Plain
MODERATE	6. Vegetated Mountain Faces
LOW	2. Cabinet Shoulders

FIGURE 3-11.

VISUAL ABSORPTION CAPABILITY

Libby Creek roads. These roads are classified level 2 or moderate sensitivity. Most of the travel routes located in the valley offer very limited view duration. Generally, vegetation screening is in the foreground with the Cabinet Mountains in the background. The Libby Creek Recreation Gold Panning Area, with level 1 or high viewer sensitivity, is located in this landscape type. It would be crossed by the proposed transmission line.

Vegetated mountain faces. This type would be crossed by all transmission line routes; it is the most common type in the transmission line corridor area. Topography in this type is generally steeply sloped with a low landform diversity. Typically, the area is heavily forested with coniferous trees. A fair amount of timber harvesting has occurred, resulting in pioneer species regeneration.

The Teeters Peak Trail, Barren Peak Trail, and portions of the Libby Divide Trail are all located within this landscape type. These recreation trails are classified level 2 or moderate sensitivity. Views from high points along these trails are panoramic, offering views to most of the valley floor and Cabinet Mountains. Extended view durations exist on roads such as the Horse Mountain Road, that climb in the same direction for long distances. The Howard Lake campground with level 1 or high viewer sensitivity, is also located in this landscape type. The proposed transmission line would be visible about one-quarter mile south as it passes east of the campground.

Open mountain faces. Segments of all three transmission line alternatives would cross this landscape type. Found primarily on south and west-facing slopes within the Miller Creek drainage, on Horse Mountain, and along the Fisher River, these areas provide a moderate-to-high visual absorption capability. Topography is generally steep and contains well dissected slopes. Vegetation type and color are diverse, with open grassy areas interspersed with coniferous trees. Timber harvesting has also contributed to the diverse vegetation patterns. The Miller Ridge Trail and portions of the Libby Divide Trail with level 2 or moderate sensitivity are found in this landscape type. These ridge trails offer more open, panoramic views of long duration.

Valley plain. The Fisher River corridor, with moderate-to-high visual absorption capability, comprises this type. It has gentle to flat terrain and a diversity of vegetation patterns and colors. All three transmission line alternatives would cross this corridor four to five miles north of the proposed Sedlak Park substation. Deciduous riparian vegetation, conifers, and irrigated pastures contribute to the diverse vegetation patterns and colors. U.S. 2 with level 1 or high sensitivity follows this corridor. Views from along highway are of short duration and are sometimes screened by adjacent vegetation. Scattered rural residences also are present. Views from residences are of long duration. Vegetation surrounding individual residences determines the openness of the views.

Riparian valley. The Schrieber Lake/Swamp Creek valley and Miller Creek valley comprise this landscape type. The flat topography of these valley floors, high vegetation diversity, and limited view distances combine to give high visual absorption capability to these areas. Views from roads that traverse these narrow valleys are typically limited to the foreground by vegetation and surrounding steeper topography. Openings created by timber harvesting or agricultural lands provide more open and longer distance views.

RECREATION

Recreational use in the project area occurs within two districts of the KNF—the Cabinet Ranger District and the Libby Ranger District. There are 418,000 acres within the Cabinet Ranger District and 350,000 acres within the Libby Ranger District. The KNF has management responsibility for recreational uses of these lands. The Montana Department of Fish, Wildlife, and Parks manages wildlife populations

and sets limits on fishing and hunting activities. All surface facilities would be located within the Libby Ranger District of the KNF.

Recreational Uses

The most prevalent form of recreation in both districts is travel and viewing, comprising nearly 66 percent of the total recreational use in the Libby District (Table 3-20). Other forms of recreation in the Libby Ranger District are individually less than 10 percent of the total recreational use. Travel and viewing in the Cabinet district is slightly less than half of the total; hiking and horseback riding, and camping and picnicking are also important recreational uses. Some the major recreational uses are described in the following sections.

Travel and viewing. Travel and viewing is a diverse form of recreation that occurs along the forest roads within the project area. The most heavily used roads are the Libby Creek Road and the Bear Creek Road.

Table 3-20. Recreational use by activity type.

Activity	Entire forest	Cabinet District	Libby District
	—(thousands of visitor days)—		
Camping & picnicking	332.9	21.5	10.0
Travel & viewing	600.2	74.9	116.0
Hiking & horseback riding	104.7	29.5	10.7
Winter sports	20.2	1.7	2.8
Resorts & cabins	20.8	—	.4
Wilderness	7.7	3.0	11.0
Hunting	93.2	20.3	4.5
Fishing	224.6	10.9	7.4
Nature studies	20.6	—	6.8
Other recreation	93.1	—	4.0
Total	1,518.0	161.8	173.6

Source: Noranda Minerals Corp., 1989a. V. 1, pp. I-143-4.

Less travelled roads used for travel and viewing connect with the two primary roads.

Camping and picnicking. The Howard Lake campground is the only fee campground within the project area. The campground fee is $5 for each night of camping; fee camping season is from Memorial Day to Labor Day. The campground gets limited use outside the fee period. Over the past five years, camping use has ranged from a low of 640 visitor days in 1987 to a high of 1,750 visitor days in 1988, and averages nearly 1,400 visitor days. The KNF estimates that fee camping comprises just under 30 percent of the total visitor use (Glenn Gibson, Libby Ranger District, pers. comm., January 10, 1990).

Hunting. The Cabinet Ranger District regulates the activities of 21 outfitters, who act as guides for hunting and fishing. The Libby Ranger District has four permitted outfitters. Actual service days for the outfitters in the Libby Ranger District in 1988 were 145. Planned service days in 1989 were 265.

Resident and nonresident elk licenses are sold statewide and are valid statewide. The mine area is located in elk hunting district #103, from which 214 elk were harvested in 1988. Elk hunting success ratio for this district, based upon hunter survey results, is estimated to be 10 percent.

Firewood gathering. A firewood permit is required for the collection of firewood on the KNF by individuals. Each permit allows the holder to gather at least two cords of firewood and can be used throughout all National Forests in the region. A total of 373 firewood permits were issued for the Libby Ranger District in 1989. Firewood collection in the proposed project area occurs primarily near established roads.

Gold panning. The Libby Creek Recreation Gold Panning Area offers the general public the opportunity to pan for gold in a historic area of placer mining. This area was acquired by the KNF in 1987 and opened to public access in 1988. Present use is low, but is expected to increase as the public learns of this recreation opportunity.

Winter activities. Winter activities include ice fishing, cross-country skiing and snowmobiling. Winter activities in the project area are highest near Bear Creek and Poorman Creek, which provide good areas for skiing and snowmobiling. Portions of the Bear Creek Road are plowed all winter, providing skiing and snowmobiling access to Bear Creek and Poorman Creek areas. The Libby Creek Road is plowed by Lincoln County to the Crazyman Road and some winter activities occur on that road. Howard Lake is used for ice fishing.

Estimates of Recreational Use

Total traffic counts for the Libby Creek Road (USFS Road 231) in 1989 indicate a total of 13,397 vehicles for the period of July 13 through November 20, an average of 103 vehicles per day. Total traffic counts in 1989 for the Bear Creek Road (USFS Road 278) indicate a total of 16,438 vehicles for the period of May 16 through November 20, with an average of 87 vehicles per day. The annual number of recreation visitors on the Libby Creek Road is estimated to be greater than the Bear Creek Road. Some of the measured traffic on both roads is related to the Montanore Project.

Trails. Three trails in the Cabinet Ranger District provide access to portions of the Cabinet Mountains Wilderness potentially affected by the Montanore Project. These trails are St. Paul Lake, Wanless Lake, and Rock Lake.

The Libby Ranger District has two type of trail heads, "managed" and "unmanaged." There are no managed trail heads in the project area. The Libby Ranger District maintains registration boxes at 12 managed trail heads, one of which, Leigh Creek, is located near the mine area. Many of the trail heads in areas where the surface facilities would be located are unmanaged. Trails in the vicinity of the proposed surface facilities are used by a very small percentage of the visitors to the Libby Ranger District (Table 3-21). Summer trail use for managed trailheads accounts for nearly 80 percent of the total use.

Table 3-21. Unmanaged trail heads in the project vicinity.

Trail	Visitors	Summer visitor days
Snowshoe Creek	10	25
Big Cherry Creek	10	10
Bear Creek	100	100
Cable Creek	25	25
Poorman Creek	25	50
Ramsey Creek	25	25
Libby Creek	25	50
Gloria	10	25
Wayup	10	25
Great Northern	10	25
Project area total	250	360
District total	5,081	12,045

Sources: Noranda Minerals Corp. 1989a. V. 1, p. I-141; and C. Howard, KNF Resource assistant, pers. comm. w/ M. Stanwood, May 15, 1990).

TRANSPORTATION

U.S. 2

U.S. 2 is the principal highway in the vicinity of the proposed project. U.S. 2 runs from the western border of Montana eastward through Troy, Libby, and Kalispell. U.S. 2 is a paved, all-weather highway that would be used by all vehicles going in and out of the project area.

The Montana Highway Department recently widened and resurfaced U.S. 2 from south of Libby to the Libby Creek crossing. The improved portion of U.S. 2 extends past the intersection of the two potential access routes to the mine area. The speed limit on U.S. 2 for the first several miles south of Libby is 45 miles per hour (mph); the speed limit then increases to 55 mph.

Traffic information. Table 3-22 shows 1988 average daily traffic (ADT), the 1988 level of service, the ADT projected for the year 2008, and the pavement service index (PSI) for four mileposts on U.S. 2

Table 3-22. Existing and projected traffic—U.S. 2.†

U.S. 2 milepost	1988 ADT	1988 Level of service‡	2008 ADT
32.7	7,411	A	10,131
33.3	4,824	A	6,594
37.3	3,149	C	3,880
44.7	1,150	C	1,429

Source: Noranda Minerals Corp., 1989a. V. 1, p. I-112 and I-112a.

†Information is for all lanes.

‡Level of service A provides for the free flow of traffic. The average speed is (at least) the posted speed limit. The speed of vehicles is unaffected by traffic. Level of service C results in the average speed being 5 mph less than the posted speed limit. Oncoming traffic impedes passing.

between Libby and the Libby Creek Road. The current vehicle mix is approximately 40 to 50 percent passenger vehicles, 25 to 30 percent passenger trucks, 8 percent mid-size trucks, 5 to 8 percent single-unit trucks, and 4 percent other vehicle types.

Table 3-23 indicates the distribution of traffic on U.S. 2 by time of day at milepost 35. The peak traffic period is from 3 PM to 5 PM. Traffic volumes on U.S. 2 can vary considerably, depending on area logging activities. Volumes are greatest during the summer tourist season.

Table 3-23. Distribution of daily traffic—U.S. 2.

Time period	Percent
Midnight to 5 AM	2.3
5 AM to Noon	31.2
Noon to 5 PM	37.2
5 PM to Midnight	29.5

Source: Noranda Minerals Corp. 1989a. V. 1, p. I-112a.

Accidents. The total accident rate on U.S. 2 is about 26 percent lower than the Montana average. The severity rate for all accidents on U.S. 2 is about seven percent lower than the Montana average. The truck accident rate on U.S. 2 is about the same as the statewide truck accident rate in Montana. Finally, the truck accident severity rate on U.S. 2 is about 37 percent greater than the Montana average.

Accident statistics further show that accidents along U.S. 2 involve another vehicle about as frequently as the Montana average; accidents involving collisions with animals occur 63 percent more frequently than the Montana average; and accidents involving collisions with fixed objects along U.S. 2 are about the same as the statewide average. Light, power, or signal poles are more likely to be struck along U.S. 2 than on average in Montana. A disproportionate share of accidents on U.S. 2 occurs during rainy conditions.

Bridges. All of the bridges on U.S. 2 between Libby and the Fisher River are concrete bridges. These bridges are designed for legal (80,000-lb.) highway loads. The bridges over Libby Creek and the Fisher River were rebuilt in 1988, replacing old structures.

Roads

Two Forest Service roads currently provide access to (or close to) the proposed mine area from U.S. 2—USFS Roads 278/4781, known as the Bear/Ramsey Creeks Roads, and USFS Road 231, known as the Libby Creek Road.

Bear Creek Road. This road joins U.S. 2 about 7 miles south of Libby and runs southwest approximately 15 miles to the mine area. The first 9.5 miles is an 18-foot, single-lane asphalt road. The speed limit is 25 mph. The degree of intervisible turnouts (allowing motorists to see from one turnout to the next) is 50 percent.

The next 4.5 miles of the Bear Creek Road (to the intersection with USFS Road 231, the Libby Creek

Road) is an 18-foot gravelled road. The speed limit is 25 mph. The degree of intervisible turnouts is 50 percent. From the intersection with the Libby Creek Road, USFS Road 4781 continues southwest for about five miles.

The current traffic volume on the Bear Creek Road is between 50 to 100 vehicles per day. About half of this traffic is estimated to be from logging activities.

Bear Creek Road is not an all-weather road and is closed during spring break-up for vehicles weighing over 10,000 pounds. The peak season of use is from June through September. The road can generally be traveled by all types of vehicles, unless mud or snow requires the use of 4-wheel drive vehicles. Most of the road is not plowed in winter, and when snow is deep, the road is impassable except for snowmobiles. The Bear Creek Road carries logging and recreational traffic, including snowmobiles.

There is one bridge along the Bear Creek Road, at Bear Creek. It is a wooden structure designed to accept legal highway loads. A culvert is used to cross Poorman Creek.

Libby Creek Road. This road leaves U.S. 2 about 12 miles south of Libby and runs southwest approximately 12 miles to the mine area. Current traffic volume is a little greater than on the Bear Creek Road, ranging between 20 and 120 vehicles per day.

The first 9.2 miles is a 14-foot, single-lane, gravel-surface road. The speed limit is 25 mph. The degree of intervisible turnouts is 75 percent. The next 2.4 miles of the Libby Creek Road (from the intersection with the Bear Creek Road to the bridge to Howard Lake) is a 12-foot single-lane aggregate surface road. The design speed is 20 mph. The degree of intervisible turnouts is 50 percent. The third section (USFS Road 2316) runs from the Howard Lake bridge to the end of the road on Libby Creek. It is a 12-foot single-lane native surface road. The design speed is 15 mph. There are no intervisible turnouts.

The Libby Creek Road is not an all-weather road. It is closed during spring break-up for vehicles weighing over 10,000 pounds. The peak season of use is from June through August. The road can generally be traveled by all types of vehicles unless mud or snow requires the use of 4-wheel drive vehicles. The majority of the road is not plowed, and when snow becomes deep, the road becomes impassible except to snowmobiles. It then remains closed until the spring melt. The Libby Creek Road carries logging and recreational traffic, including snowmobiles.

There are two single-lane bridges along the Libby Creek Road over Libby Creek which are designed for legal highway loads. The first bridge is concrete, and was constructed in 1981. The second bridge, near the Old Town site, is a concrete structure, capable of supporting legal highway loads (80,000 lbs.), constructed in 1984 after a flood destroyed the old bridge.

There are several roads capable of providing access for construction of the proposed transmission line or alternative routes—U.S. 2 along the Fisher River and Swamp Creek; a haul road owned by Champion International Corporation. east of the Fisher River; USFS Road 4778; the Midas Creek Road; USFS Road 231 (the continuation of the Libby Creek road past Howard Lake); and USFS Roads 385/4724 in the Miller Creek drainage.

Rail, Bus, and Air Service

The town of Libby is on the east-west route of the Burlington Northern Railroad. Daily freight service is provided, with major destinations being Seattle and Chicago. Amtrak passenger service is also provided at Libby. There is no interstate bus service to Libby. Libby has one local car rental agency. United Parcel Service and Federal Express provide service to Libby.

The nearest airports providing scheduled air transportation are Kalispell and Spokane, Washington. Kalispell is approximately 90 miles and 1.5 hours driving time. Spokane is about 160 miles and three hours driving time. The Libby Municipal Airport is

open 24 hours per day, under visual flight rules. Mountain West Flying Service, a local business, offers charter air service from the Libby Airport.

SOCIOECONOMICS

Study Area

Various factors may influence the location and magnitude of potential socioeconomic impacts. These include—

- the location of and access to the ore body and to the proposed permit area;
- the likely residence area for people working at the mine (existing residents and/or any in-migrating project employees);
- the rate and magnitude of in-migration (which will be influenced by the availability of a trained or trainable local workforce and a developer sponsored training program);
- the rate and magnitude of population and employee turnover (including student population turnover in schools, employee turnover at the mine, and employee turnover from existing jobs to employment with the Montanore Project);
- the availability and location of housing and existing and potential housing sites;
- in relation to potential housing locations, the capacity and condition of existing local services and facilities;
- the people directly/indirectly affected economically by the proposed mining operation (e.g., from wages and taxes); and
- the willingness and ability of community residents and local government personnel to deal with change.

Based on these factors, the primary socioeconomic impact area for the proposed project is the southwestern portion of Lincoln County along U.S. 2 between Troy and Libby. Affected jurisdictions in the study area include Libby and Troy (both incorporated cities), Lincoln County, and the Libby and Troy School Districts.

Relevant baseline information is also presented on the existing socioeconomic environment for Sanders County. The ore body is located in Sanders County, and cumulative impacts may have some effect in Sanders County. As discussed in Chapter 4, nobody is expected to move to Sanders County as a direct result of the proposed project. Most of the information in this section is current through the last six months of 1988.

Employment and the Economy

The Lincoln County economy is natural-resource based, with the lumber industry playing an important role. Manufacturing (including timber harvesting and wood products manufacturing) is nearly 18 percent of all Lincoln County businesses (Table 3-24). The major wood products employer is Champion International Corporation, located in Libby. Champion, the largest employer in the county, employs approximately 700 people at full production and, depending on the time of year, also contracts with several hundred independent loggers. The characteristics of the wood products industry create a complicated and highly cyclical economy. Unemployment rates for this industry vary from year-to-year and season-to-season, ranging from almost 20 percent during the winter, to around 10 percent during the summer.

Three mining employers in Lincoln County account for about 7 percent of all county employment. In 1979, ASARCO, Inc. developed the Troy Mine, a silver and copper mine south of Troy, which employs about 350 workers. W.R. Grace & Company operates a vermiculite mine near Libby employing about 85 people during full operations. W.R. Grace announced in May, 1990 that operations would cease at this mine in about September, 1990.

Other major private employers in Lincoln County are in the services and transportation, communication and public utilities sectors. The key employer in the services sector is St. John's Lutheran Hospital in Libby. Major employers in the transportation,

Table 3-24. Private business establishments by employment size—Lincoln County.

Category	Total number of establishments	Number of employees 1-4	5-9	10-19	20-50	Over 50
Mining	3	1	0	0	0	2
Construction	27	22	4	1	0	0
Manufacturing	87	45	21	13	6	2
Transportation	22	14	4	2	2	0
Wholesale trade	12	6	5	1	0	0
Retail trade	138	84	32	15	6	1
Finance, insurance and real estate	16	13	0	1	2	0
Services	123	91	17	9	5	1
Other	64	60	2	2	0	0
All establishments	492	336	85	44	21	6

Source: Economic Consultants Northwest. 1989. p. 4.

communication and public utilities sector include Pacific Power and Light and General Telephone Company.

The largest government employers in Lincoln County are the U.S. Forest Service, the U.S. Army Corps of Engineers, the Bonneville Power Administration, Lincoln County, the Libby and Troy School Districts, and the municipalities of Libby and Troy. Total Forest Service employment in the county is about 300 full-time employees, plus a significant number of seasonal employees. Lincoln County's employment data are presented in Table 3-25.

The civilian labor force in Lincoln County has grown from 7,275 in 1970 to 8,725 in 1988, a 19.9 percent increase in 18 years. This is a much slower growth rate than the 47.3 percent increase in the statewide labor force over the same period. The Lincoln County labor force has remained in a narrow range since 1982, with a low of 8,497 and a high of 8,897 from 1982 to 1988.

The average unemployment rate in Lincoln County varied from 8.9 percent in 1970 to 15.5 percent in 1980. Since 1985, the unemployment rate in Lincoln County has ranged from 11.0 to 11.6 percent. This rate is higher than the state rate, which averaged 7 percent over the last 18 years. The Lincoln County unemployment rate varies between 10 and 18 percent within any year due to the seasonality of the wood products industry.

Table 3-26 presents job applicants by mine-related occupational groups registered at the Libby Job Service Office over an 11-month period in 1987 and 1988. These groups represent applicants who could potentially be trained to work in construction and operation jobs of underground mines, such as the proposed project. The total number of applicants varies between 900 and 1,300 over the period.

In 1987, the average wage for all workers in Lincoln County was $334 per week (Table 3-27), nearly 6 percent higher than the average wage of all Montana workers. The mining industry in Lincoln County pays over 50 percent above the average and is the highest paying group in the county. In 1986, per capita income for residents of Lincoln County was $9,379 according to the U.S. Department of Commerce. This income level is over $5,000 less than the national per capita income and over $2,000 less than the state per capita income figure of $11,726. Total 1986 earnings reported in Lincoln County by the U.S. Department of Commerce was about $126 million.

Table 3-25. Employment by industry—Lincoln County.

Industry	1970	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total Employment	7,042	6,948	7,024	6,852	7,397	7,393	7,357	7,590	7,512	7,638
Farm	133	251	268	286	303	298	295	294	285	282
Nonfarm	6,909	6,697	6,756	6,566	7,094	7,095	7,062	7,296	7,227	7,356
Private	5,732	5,101	5,270	5,057	5,603	5,540	5,597	5,884	5,808	5,963
Agricultural Services	92	167	135	171	235	253	238	270	213	230
Mining	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	488	470
Construction	1,610	419	424	415	414	307	311	323	271	439
Manufacturing	1,731	1,421	1,436	1,092	1,397	1,425	1,497	1,545	1,669	1,574
Transportation, Communication, and Public Utilities	347	447	357	326	345	359	338	372	378	404
Wholesale Trade	73	82	94	91	97	93	96	91	72	65
Retail Trade	853	999	1,054	1,001	1,098	1,064	1,015	1,047	1,121	1,163
Services	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	1,319	1,352
Finance, Insurance, and Real Estate	118	256	264	276	290	285	296	320	277	266
Government	1,177	1,596	1,486	1,509	1,491	1,555	1,465	1,412	1,419	1,393
Federal (civilian)	457	759	704	670	676	611	570	507	525	515
Federal (military)	142	107	84	81	96	100	99	107	111	112
State and Local	578	730	698	758	719	844	796	798	783	766

Sources: Economic Consultants Northwest. 1989. p. 13. and U.S. Dept. of Commerce, pers. comm. w/ R. Stanwood, 1990.
(D) = Data not shown to avoid disclosure.

Table 3-26. Job applicants—Libby Job Service Office.

Occupation category	1987			1988							
	Oct.	Nov.	Dec.	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.
Equipment operators	136	108	96	116	153	166	157	NA	141	148	118
Truck drivers	98	37	91	99	123	134	133	NA	120	91	100
Technicians (mine-related)	134	96	102	78	158	186	156	NA	141	145	115
Mechanics	58	18	40	13	68	71	64	NA	57	61	47
Laborers	635	540	484	573	715	731	736	NA	792	733	609
Other	197	178	169	53	220	245	242	NA	215	227	167

Source: Economic Consultants Northwest. 1989. p. 11.

Table 3-27. Average weekly wages—Montana and Lincoln County, 1987.

Industry group	Montana average weekly wage	Lincoln County: Average weekly wage	Lincoln County: Percent of state	Lincoln County: Percent of of county average
All industries	$316	$334	105.7	100.0
Mining	561	511	91.1	153.0
Federal government	470	449	95.5	134.4
Manufacturing	414	412	99.5	123.4
Transportation	445	362	81.4	108.4
State government	387	330	85.3	98.8
Local government	324	330	101.9	98.8
Wholesale trade	381	324	85.0	97.0
Construction	396	323	81.6	96.7
Finance, insurance and real estate	354	234	66.1	70.1
Agricultural services	232	205	88.4	61.4
Services	266	175	65.8	52.4
Retail trade	182	156	85.7	46.7

Source: Economic Consultants Northwest. 1989. p. 18.

Recent data indicate there is no dominant industry in Sanders County. In the manufacturing sector, Washington-Idaho Forest Products is the largest single employer with up to 140 employees, plus 100 to 150 independent loggers during full production. There are only two mining operations in Sanders County. The largest is U.S. Antimony Company, which operates a small mine and concentrator facility employing 35 people during full operation.

The major employer in the services sector in Sanders County is Clark Fork Valley Hospital in Plains. Other employers in the services and retail trade sectors are dispersed throughout the many small towns and communities in Sanders County. The U.S. Forest Service, Sanders County, school districts, and local governments are the primary government employers.

The civilian labor force in Sanders County increased 48 percent from 1970 to 1980, but declined by nearly 18 percent between 1980 and 1985. Since 1985, the labor force has remained stable, with 3,283 people reported in the civilian labor force in 1988. The unemployment rate in Sanders County has averaged 14.5 percent since 1980, twice the unemployment rate for Montana. In 1988, an estimated 13 percent of the total civilian labor force was unemployed in Sanders County. Most of the unemployed are former employees of the manufacturing (wood products) industry.

The average weekly wage in Sanders County was $277 in 1987, nearly 13 percent lower than the Montana average. The highest paying jobs in Sanders County are with the federal government. Per capita income in Sanders County in 1986 was estimated by the U.S. Department of Commerce at $8,724, 60 percent below the national figure and 74 percent below the state amount.

Population and Demographics

The population of Lincoln County more than doubled from 1940 to 1970 (Table 3-28). The largest increase for Lincoln County was between 1960 and 1970 during the Libby Dam construction. The population decline between 1970 and 1980 was due

Table 3-28. Comparison of selected demographic characteristics—Montana, Lincoln County, Libby and Troy.

Characteristic	Montana	Lincoln County	Libby	Troy
Population				
1940	559,456	7,882	1,837	796
1950	591,024	8,693	2,401	770
1960	674,767	12,537	2,828	855
1970	694,409	18,063	3,286	1,046
1980	786,690	17,752	2,748	1,088
Female (1980)	50.1%	49.5%	53.2%	52.5%
Under 18 Years	28.6%	33.4%	28.4%	36.3%
18 to 64 Years	59.3%	57.9%	54.0%	51.3%
65 Years and Over	12.1%	8.7%	17.6%	12.4%
Median Age	29.6 Years	28.5 Years	NA	NA
Male (1980)	49.9%	50.5%	46.8%	47.5%
Under 18 Years	30.3%	34.2%	29.4%	33.3%
18 to 64 Years	60.3%	58.4%	58.8%	57.2%
65 Years and Over	9.4%	7.4%	11.8%	9.5%
Median Age	28.4 Years	28.3 Years	NA	NA
Households (1980)	283,742	6,063	1,003	394
Persons Per Household	2.70	2.91	NA	NA
Persons Per Family	3.24	3.37	NA	NA
Race (1980)				
White	94.1%	97.9%	98.6%	98.8%
Native American	4.7%	1.3%	1.4%	1.0%
Other	1.2%	0.8%	0.0%	0.2%
Percent completing 12 years or more of school (1980)	75.4%	68.7%	NA	NA
Median Family Income (1979)	$18,413	$17,480	NA	NA

Source: Economic Consultants Northwest. 1989. p. 69.

to the dam completion. Population of Libby and Troy increased slowly between 1940 and 1980, with growth rates about the same as the state-wide rate.

Since 1980, the population of Lincoln County has increased steadily (Table 3-29). The estimated population of Libby has declined since the 1980 census. Troy's 1987 population was only slightly higher than the 1980 census population.

The population of Sanders County increased 25 percent between 1940 and 1980, a growth rate about 50 percent of the state rate (Table 3-29). Sanders County population made modest gains from 1980 through 1984. Since that time, Sanders County has lost population at about the same rate as the state as a whole.

Table 3-29. **Population components of Montana, Lincoln County, and Sanders County.**

Place/Year	Estimated population	Births	Deaths	Estimated migration
Montana				
1980	786,690	14,208	6,664	1,766
1981	796,000	14,309	6,709	1,400
1982	805,000	14,538	6,625	3,087
1983	816,000	14,054	6,699	645
1984	824,000	14,141	6,698	-6,443
1985	825,000	13,497	6,725	-14,772
1986	817,000	12,728	6,738	-13,990
1987	809,000	12,239	6,597	--
Lincoln County				
1980	17,752	340	123	-169
1981	17,800	312	114	2
1982	18,000	337	125	88
1983	18,300	367	134	167
1984	18,700	295	128	-67
1985	18,800	297	149	-348
1986	18,600	260	138	278
1987	18,900	265	133	--
Libby				
1980	2,748	53	19	-82
1981	2,700	47	17	-30
1982	2,700	51	19	-32
1983	2,700	54	20	-34
1984	2,700	43	18	-125
1985	2,600	41	21	-20
1986	2,600	36	19	-17
1987	2,600	36	18	--
Troy				
1980	1,088	21	8	-1
1981	1,100	19	7	-12
1982	1,100	21	8	87
1983	1,200	24	9	-15
1984	1,200	19	8	-11
1985	1,200	19	10	-9
1986	1,200	17	9	-8
1987	1,200	17	8	--
Sanders County				
1980	8,675	128	83	-20
1981	8,700	146	83	237
1982	9,000	155	99	-56
1983	9,000	132	100	168
1984	9,200	163	84	-179
1985	9,100	142	74	-268
1986	8,900	127	96	-131
1987	8,800	115	96	--

Source: Economic Consultants Northwest. 1989. pp. 72 and 121.

Community Services and Facilities

Schools. There are four elementary schools, one junior high school, and two high schools in the Libby/Troy area. Libby School District #4 includes Asa Wood, McGrade, and Plummer elementary schools, Libby Junior High School, and Libby Senior High School. Troy School District #1 includes Morrison School (kindergarten through grade 8) and Troy High School (grades 9 through 12). In the 1988-89 school year, Libby School District schools were staffed as follows—

- elementary schools—42 classroom teachers and 5 special education teachers;
- junior high school—35 classroom teachers and 2 special education teachers; and
- high school—34 classroom teachers and 2 special education teachers.

In the 1989 school year, Troy's school staff included 24 classroom and 5 special education/chapter teachers at the elementary level, and 17 classroom and 2 special education/chapter teachers at the high school level.

School enrollment in the Libby School District decreased 17 percent from 2,560 in 1980-81 to 2,126 in 1988-89. There is presently a ratio of 19.2 students per teacher in the district. Troy School District school enrollment fluctuated between 1980 and 1988, from a low of 571 in 1982-83, to a high of 719 in 1985-86. In the 1988-89 school year, 685 students were enrolled resulting in an overall ratio of 16.7 students per classroom teacher in the Troy district. Table 3-30 shows estimated physical capacity compared to 1988-89 school enrollment in both districts.

Law enforcement. The Montana Highway Patrol, the Lincoln County Sheriff's Department, and the Troy Police Department provide law enforcement services in the Libby/Troy area. The Sheriff's Department is a consolidated city and county law enforcement agency headquartered in Libby. Four Montana Highway Patrol officers serve the Lincoln

Table 3-30. Current enrollment and estimated physical capacity—Lincoln County schools.

School	1988-89 Enrollment	Estimated capacity
Libby School District #4		
Asa Wood Elementary	439	500
McGrade Elementary	299	324
Plummer Elementary	299	324
Libby Junior High	612	1,000
Libby Senior High	459	900
Troy School District #1		
W.F. Morrison (K-8)	469	525
Troy High School (9-12)	208	230

Source: Economic Consultants Northwest. 1989. pp. 87 and 92.

County study area—one sergeant and three patrol officers in Libby. Of the 14 deputies in the Sheriff's Department, one resides and patrols in Troy, and 11 are in the Libby area. The Sheriff's Department maintains 12 patrol cars. The Troy Police Department has two full-time officers and owns two patrol cars. There are two jails in the study area—a 24-cell adult jail in Libby and a 2-cell juvenile holding facility in Troy.

Fire protection. Fire protection is provided by two rural fire districts (Libby and Troy), the Libby Fire Department, and the Troy Fire Department, all volunteer. The Montana Department of State Lands and the U.S. Forest Service are responsible for fire protection in lands under their jurisdiction. The rural/city Libby Fire Department has 28 volunteers, two firehalls, and eight fire trucks. The Troy rural/city Fire Department has 25 volunteers, one firehall, and seven firefighting vehicles.

Ambulance services. Ambulance services are provided by the Libby Volunteer Ambulance Service and the Troy Volunteer Ambulance Service. The Libby Ambulance Service has an active volunteer staff of 30, with 75 percent trained as emergency medical technicians (EMTs). The Troy Ambulance

Service operates with 24 volunteers with ten certified EMTs and three trained in emergency mine rescue.

Hospital and physician services. St. John's Community Hospital in Libby is the only public hospital in Lincoln County. In 1987, the 26-bed hospital operated at 48.7 percent capacity. The hospital offers 24-hour emergency care services. The Libby area is served by 15 licensed physicians and the Troy area is served by two licensed physicians, one of whom is on inactive status.

Water supply. More than 50 percent of the households in Lincoln County use private wells for water supply. In Libby, approximately 2,000 households and commercial businesses are served by the municipal water system, which obtains water from Flower Creek. Raw water storage capacity is 80 million gallons. The town of Troy receives its municipal water supply from two wells and O'Brien Creek. The Troy municipal system provides water to an estimated 450 residences and 53 commercial establishments.

Sewage treatment facilities. Approximately 76 percent of the households in Lincoln County, including the town of Troy, use septic tanks for wastewater disposal. The city of Libby has operated a public wastewater treatment facility since 1964, and in 1985, converted from a primary to a secondary treatment facility (i.e., an activated sludge oxidation ditch system). The Libby wastewater facility operates at approximately 50 percent of design capacity, processing 1.1 million gallons per day.

Solid waste disposal. Lincoln County operates a solid waste district for collection and disposal of solid, non-hazardous waste. The two landfills in the study area are located in Libby and Troy. Only solid inert material can be disposed at the Troy landfill site. The county places waste containers in rural areas for waste collection. Private trash collectors also serve the county.

Human services. The Human Services office is located in Libby with a staff of 14. Funding for the social welfare program comes from state, federal, and county sources with the state administering the program. Support includes aid to families with dependent children, food stamps, medical services, general assistance, and fuel assistance.

Libraries. There are three public libraries in Lincoln County. The main library is located in Libby, with branch libraries in Troy and Eureka.

Adequacy of existing facilities and services. Table 3-31 shows a summary of comments by officials within county and city agencies regarding the adequacy services. There are no county-accepted community services and facility standards upon which to gauge adequacy.

Housing

The 1980 census data are the most recent, detailed data on housing. While this information is now almost ten years old, data are still representative of the general housing mix in the county. Census data show 6,815 year-round housing units in Lincoln County with 6,063 occupied—74.4 percent by owners and 25.3 by renters. Two-thirds of the year-round housing units are classified as one-unit structures. Nearly 25 percent of the housing units in Lincoln County are mobile homes, twice the state level. The majority of homes were constructed between 1960 and 1980. About 4.4 percent of housing units in Lincoln County lacked complete plumbing facilities for exclusive occupant use according to the 1980 census. This is higher than the average of 2.3 percent for the state of Montana.

Real estate for sale or rent was monitored weekly in *The Western News* for six months in 1988 (Table 3-32). The average number of housing units (homes, mobile homes, and rental housing units) available during this period was 53 units. On November 4, 1988, the Multiple Listing Service had 91 residential listings for sale (30 with acreage and 61 without acreage). In a poll taken by *The Western News*, local realtors reported that real estate prices in the area were leveling off in November 1988 from an 8-year decline and home prices were stabilizing at a

low level, with listing price only 40 to 60 percent of replacement value.

City zoning regulations prohibit mobile homes within Libby city limits; Lincoln County has no restrictions on mobile home placement other than those required by the state. A Lincoln County Department of Environmental Health survey (June, 1988) indicates 667 mobile home spaces near Libby with an occupancy rate of 69 percent, and 75 spaces near Troy with an occupancy rate of 61 percent.

Rental housing is not plentiful in Libby and Troy. In a survey of realtors conducted by *The Western News* in November 1988, it was reported "home rentals are vanishing as more people–retirees, miners, business–are moving into the area than are moving out." Another reason for the tight rental market is that many new residents cannot afford or will not make the long term commitment required for the purchase of a home.

There are approximately 125 rental apartments in the Libby area. Vacancies fill quickly. Rental housing in Troy is also scarce. An estimated 16 percent of 263 motel rooms in Libby and Troy are equipped with cooking facilities. Most of the motels have weekly or monthly rates, particularly during the relatively slow winter period.

Table 3-31. Comments by officials on the adequacy of community and facilities and services.

Agency/Service	Contact	Date	Comment
Libby schools	Sheviee Wynes	11/4/88	Adequate staff
		2/8/89	Central school could be reopened if capacity becomes problem.
Troy Schools	Mary Brown	11/4/88	Psychologist needed for K-8; otherwise, staff adequate.
Lincoln Co. Sheriff Dept.	Ray Nixon	9/16/88	3 patrol officers needed; vehicles getting old.
Troy Police Dept.	Bill Dutton	9/15/88	Adequate staff and vehicles.
Libby Fire Dept.	Bill Kemp	11/2/88	Adequate volunteers and equipment.
Troy Fire Dept.	Max Schrader	11/2/88	Adequate volunteers and equipment.
Libby Ambulance Service	Dan Stephens	11/2/88	Adequate vehicles, additional volunteers needed.
Troy Ambulance Service	Warren Robbe	11/8/88	Additional volunteers, special equipment and truck needed.
St.John's Hospital	Nancy Bloom	9/15/89	Adequate beds and staff.
Libby Water Supply	Bill Allen	9/20/88 and 4/9/88	Leaks in system a problem; studying options.
Troy Water Supply	Melvin Price	3/11/88	Adequate system which can handle additional growth.
Libby Wastewater Treatment Facility	Al Eldridge	9/16/88	System at 50% of capacity.
Libby Landfill	Ron Anderson	9/16/89	Facility at 50% of capacity; 20 year life remaining.
Lincoln County Social Services	Susan Smith	9/16/88	Adequate staff.
Lincoln County Libraries	Inez Herrig	9/15/88	Needs additional staff.

Source: Economic Consultants Northwest. 1989. Various pages.

Fiscal Conditions

The proposed project could affect the public budgets of Lincoln and Sanders counties, the cities of Libby and Troy, and those cities' school districts. Basic descriptions of key budget areas for each of these jurisdictions are presented below. Detailed budget data and trends are presented in Appendix C.

Lincoln County. Total taxable valuation peaked in Lincoln County in fiscal year (FY) 1986 at $36.5 million. Since that time, valuation has dropped 14.4 percent, with no accompanying population decrease. The major tax base component in Lincoln County is Land and Improvements, which amounts to nearly 46 percent of the total tax base. The major revenue source to Lincoln County government is intergovernmental transfers (47.6 percent in FY 1988) including approximately $200,000 from the federal government for payment in lieu of taxes. Between 1980 and 1988, revenues from property taxes increased 78 percent from $759,188 to $1,350,312. General fund revenues also increased by approximately the same amount during this 8-year period.

Expenditures for Lincoln County peaked in FY 1986 at $323 per capita, but since then, expenditures dropped 5 percent. In FY 1988, 23.4 percent of the budget was spent on general government, 21.6 percent on public safety, and 41.3 percent on public works.

Libby. Taxable valuation for Libby has declined

Table 3-32. Six-month monitoring of real estate for sale and housing units for rent—Lincoln County.

Types of housing	Average number per week	Range
Homes for sale		
Under $30,000	6	Price: $10,000 to $550,000
$30,000 to $55,000	6	Number of acres: 0 to 480
$55,000 and over	9	Number of bedrooms: 1 to 5+
No price listed	3	
Mobile homes for sale		
Under $8,000	2	Price: $1,200 to $37,500
$8,000 to $15,000	1	Number of acres: 0 to 11.5
$15,000 and over	2	Number of bedrooms: 1 to 4
No price listed	3	
Acreage for sale		
Under 6 acres	3	Number of acres: 0.5 to 480
6 to 25 acres	2	
25 acres and over	1	
Lots for sale		
All lots	2	Number of lots: 1 to 4
Rental housing units		
Homes	10	Rent: $110 to $575 per month
Apartments	6	Rent: $100 to $275 per month
Mobile homes	5	Rent: $130 to $300 per month

Source: Economic Consultants Northwest. 1989. p. 166.

from $3.81 million in FY 1980 to $3.07 million in FY 1988, a 19.5 percent decline in the tax base. Total revenues for Libby have decreased approximately 5 percent since 1980, which somewhat masks the significant decline in property tax revenues from $294,562 in FY 1980 to $197,782 in FY 1988.

Total expenditures for Libby have changed little since FY 1980. Public works expenditures increased from 21 percent of the FY 1980 budget to about 44 percent of the current budget.

Troy. Troy's taxable valuation increased slightly between FY 1980 and FY 1987 from $700,800 to $731,400. In FY 1988, the taxable valuation declined by $60,500. Revenues to the municipality of Troy increased nearly 56 percent between FY 1980 and FY 1988. Revenue from property taxes and transfers remain stable, while revenues from other sources such as fines, fees, charges for service, and licenses and permits increased tenfold over this period. Expenditures for general government in Troy usually require about 33 percent of the budget; expenditures for public safety require approximately 40 percent of the budget.

Libby School District. Similar to the Lincoln County tax base, the taxable valuation for Libby School District #4 (elementary and high school) declined by approximately 5 percent between FY 1986 and FY 1988. Total revenues to this district increased 40.5 percent between FY 1981 and FY 1988. Most of this increase was from the state equalization program. The per Average Number Belonging (ANB) expenditures at the Libby Elementary School District rose from $3,048 per student in FY 1981 to $3,697 in FY 1987. In FY 1988, per ANB expenditures declined slightly to $3,593.

Total revenues at Libby High School District #4 rose approximately 40 percent since FY 1981. Nearly 80 percent (or $2.4 million) of total revenues raised in FY 1988 were general fund revenues. Per ANB expenditures at the high school level peaked in FY 1987 at $4,265 per student and then declined in FY 1988 to $4,057. Since FY 1981, general fund expenditures comprised approximately 80 percent of the Libby High School budget.

Troy School District. The taxable valuation for Troy School District #1 (elementary and high school) increased by almost 200 percent between FY 1981 and FY 1986. This increase is entirely attributable to the ASARCO Troy mine. Total revenues for Troy Elementary School District doubled between FY 1981 and FY 1988; expenditures increased by over 100 percent between FY 1981 and FY 1986, while per ANB expenditures increased by over one-third during this same time period. Per ANB expenditures were $3,828 in FY 1988.

Revenues at Troy High School District #1 increased by approximately 80 percent from FY 1981 to FY 1986. Since 1986, total revenues at the high school have increased approximately 15 percent. Per ANB expenditures at the high school peaked in FY 1986 at $5,470, and since that time, slight decreases in per ANB expenditures have been experienced, reaching $5,326 in FY 1988.

Sanders County. Total taxable valuation in Sanders County increased from $19.5 million in FY 1980 to $30.9 million by FY 1986. Since 1986, total taxable valuation for Sanders County has declined by 4.1 percent. Total revenues for Sanders County more than doubled between FY 1980 and FY 1986. Revenue increases are attributable both to increased property taxes and federal and state intergovernmental transfers. Per capita expenditures (in real dollars) declined between FY 1980 and FY 1986 and then increased in 1988 to $439 per person. General government expenditures usually total about 20 percent of the budget, while expenditures for public works have comprised 42 to 53 percent of the budget recently.

Social Structures and Quality of Life

Social structure and interaction in the Libby and Troy areas has been shaped primarily by geographic isolation, migration and settlement, resource extractive economy, extra-local influence on the economy, and

a cyclical economy. Large influxes of dissimilar ethnic groups have not greatly influenced the social character of the area. Railroad construction brought small, transient populations of Chinese and Greeks, but the ethnic background of most settlers was northern European. The German and Scandinavian heritage originally associated with the lumber industry is still evident in Libby. Individual reliance on one's immediate family and social groups for support has fostered cohesiveness in the Libby and Troy communities that has provided resiliency during difficult economic periods. People in the area attend church regularly and often organize groups to assist others in need. While Lincoln County residents have a slightly lower educational attainment level than Montana residents as a whole, study area residents desire a strong education for their children.

Since mining and logging are cyclic industries—influenced by national or international economics—the area is economically insecure. Industrial development capital comes primarily from external sources, and local employees may perceive that they have little influence over their destiny. Similarly, the U.S. Forest Service manages about 75 percent of the land in Lincoln County. Many Libby area residents adapt to the economy's cyclic nature by enhancing their personal resources by such activities as hunting, fishing, gardening, firewood gathering, berry picking, and other "do-it-yourself" skills. Local residents acquire vehicles, homes, and other possessions which are functional, rather than ostentatious. Many Lincoln County residents, because of their livelihoods, are closely linked to the natural environment and have a conservation ethic, but may not necessarily favor preservation that would prohibit development of natural resources.

A quality of life survey indicates Lincoln County residents highly value the natural environment and the rural, small town atmosphere of the area (Economic Consultants Northwest, 1989). Air pollution, particularly in fall and winter, was frequently mentioned as unaesthetic and a public health problem. There is a strong community identity in both Libby and Troy residents. Most residents believe they are self-reliant, but also feel the community is responsive to the unfortunate.

Area social problems reported by survey respondents include alcoholism, drugs, family abuse, teenage pregnancy, divorce, crime, and lack of motivation. Alcoholism and drugs were mentioned most often. Community services are generally viewed as average or above average. Residents typically try to buy goods in Libby, but cite limited selection as a limitation. Shopping for clothing and other small articles is often done in Kalispell or Spokane, while major purchases (such as automobiles) are often made in Libby. The economy of Lincoln County was viewed as depressed to stable, and not able to support adequate employment.

The population of Sanders County is relatively sparse and dependent on the area's natural resources for employment, recreation, and in some cases, subsistence. The limited possibilities for employment and lifestyle diversity limit contact between the local population and different people from outside the area. The relative isolation of Sanders County residents tends to have a homogenizing effect, resulting in sharing of common life experiences and developing similar perspectives toward life.

A quality of life survey indicated residents were nearly universal in their satisfaction with the county as a place to live (Economic Consultants Northwest, 1989). Like Lincoln County residents, Sanders County residents value the area's natural and rural qualities. Typically, Sanders County residents purchase major items such as automobiles from Missoula, Sandpoint, or Spokane. Local stores are thought to be high-priced and lacking in a wide selection. Community services are generally viewed as average.

Social problems reported include racism, child abuse, divorce, drugs, alcoholism, and crime, and were not consistently identified by respondents. The economy of the area is described as depressed to

stable. Important perceived local needs are additional jobs and increased wages.

Future Baseline Environment

In order to compare the effects of the proposed action on the socioeconomic environment, the conditions and characteristics describing the socioeconomic environment must be projected into the future. Baseline economic and population projections in five-year increments through the year 2010 were prepared to represent the future baseline socioeconomic environment (Economic Consultants Northwest, 1989). These projections were generated through use of a National Planning Association model using data on employment and income from the U.S. Bureau of Economic Analysis. These projections do not include the effects of the proposed project.

Total Lincoln County employment is projected to increase 7.4 percent between 1990 and 2005 (Table 3-33). This annual growth rate of 0.3 percent is consistent with historical 1970-85 trends. Most employment growth beyond 1990 is projected to occur in the private sector, with the largest gains in the services sector. Manufacturing is projected to decrease over the period 1990-2010.

The population of Lincoln County is projected to increase very gradually over the period 1990-2010. Average annual population increases are less than 0.5 percent, or approximately 60 persons per year, over this period.

Employment in Sanders County is projected to increase very marginally over the 1990-2010 period (Table 3-33). Employment increases in services, finance, and retail are offset by employment decreases in farm and manufacturing employment. Sanders County population is projected to incur an average growth rate of approximately 0.6 percent over the 1990-2010 period. These projections do not include any effects of the proposed ASARCO Rock Creek project. Chapter 4, Socioeconomics, provides a discussion of the employment and population interactions between the proposed Montanore Project, the proposed Rock Creek Project, and the closure of the ASARCO Troy mine.

CULTURAL RESOURCES

At the time of Euro-American contact, two major ethnic groups occupied and used areas which include the current project area. The Kalispell or Lower Pend d'Oreille occupied the Clark Fork river drainage from the area around Lake Pend d'Oreille in Idaho to the vicinity of Plains, Montana. The Kutenai occupied the area drained by the Kootenai River in Montana and the Kootenay and upper

Table 3-33. Employment and population baseline projections in Lincoln and Sanders counties.

	1990	1995	2000	2005	2010
Lincoln County					
Employment	7,660	7,860	8,070	8,230	8,220
Population					
County	18,140	18,330	18,610	18,920	19,280
Libby	2,808	2,837	2,880	2,928	2,984
Troy	1,112	1,124	1,141	1,160	1,182
Sanders County					
Employment	3,450	3,480	3,510	3,540	3,520
Population	9,060	9,490	9,800	10,060	10,370

Source: Economic Consultants Northwest. 1989. p. 16 and p. 48.

Columbia rivers in British Columbia. They occupied semi-permanent winter encampments and seasonally exploited other sites. The Kutenai, who subsisted on a hunting-gathering economy based primarily on fish, big game and camas, have used the project area for the last three to five centuries.

The first contact between Native Americans and Euro-Americans in the area was initiated by fur traders. The first whites to enter the project area were probably employees of the Northwest Company sent into the region in 1801. Several trading posts were established in the region and travel routes such as the "Kootenai Road" became important links to connect the Kootenai River region with the trading posts.

More permanent Euro-American settlements resulted from the influx of people during the gold strikes of the 1860s and the construction of the transcontinental railroads through the Clark Fork Valley in 1883 and the Kootenai Valley in 1892. There was placer mining along Libby Creek by 1867-1868. Settlement along the Kootenai River was limited to the town of Tobacco Plains until the late 1880s, when Old Town was established near Howard Creek's confluence with Libby Creek. Old Town was abandoned in 1889 with the establishment of Old Libby, which in turn was abandoned in 1891 when the route for the Great Northern Railroad was established closer to the Kootenai. Placer mining in the Libby Creek drainage peaked in the early 1900s. Both railroads and mining contributed to the development of the timber industry, which became the economic base in both Lincoln and Sanders counties.

A major change in the region resulted from the establishment of the Forest Reserves, later known as National Forests. Lands within the reserves came under the administration and protection of the federal government, and timber cutting became regulated. Portions of the land within the project area were included in the Cabinet Forest Reserve, now part of the Libby and Cabinet Districts of the KNF.

Native American Resources

Native American history of the project area has been described in the prehistoric and historic overviews. In accordance with the American Indian Religious Freedom Act, Native American concerns and values for cultural resources of contemporary or historical significance within the project area were addressed. The major goals of the Native American contacts were to develop an inventory of significant past or present cultural resources and the activities associated with them, and to document concerns and recommendations for preservation and/or mitigation procedures for any identified resources. To comply with these regulations, the Chairman of the Confederated Salish and Kootenai Tribes, the Kootenai Culture Committee and the Flathead Culture Committee were contacted (Historical Research Associates, Inc., 1989). An area of concern to Native Americans has been identified near the proposed Sedlak Park electrical substation.

Cultural Resource Site Types

Based on sites recorded in surrounding areas, the following cultural resource types were considered most likely to occur in the project area—prehistoric campsites, aboriginally scarred trees, historic cabins, trading posts, mining sites, logging sites, homesteads, bridges and trash dumps. The records and files search determined that 19 sites have been previously recorded within or near the project area, including two prehistoric sites, three scarred tree sites, and 14 historic sites.

At the time of the records check, one historic site (24LN786), the Swamp Creek Rural Historic District, was listed on the National Register of Historic Places (NRHP) (Historical Research Associates, Inc., 1989). At the present time, this site is no longer a historic district, but at least two of the structures are still considered eligible for the National Register of Historic Places (B. Timmons, Archaeologist, Forest, pers. comm., June 21, 1989). These resources are not located within any proposed

area of impact and there would be no direct or indirect impacts (including visual) to them. Intensive survey of the permit area located two historic cultural resource sites (24LN942, and 24LN943) and no prehistoric or ethnohistoric resources. None of the newly recorded sites is considered eligible for nomination to the NRHP, and no further work is recommended. The Forest Service and the State Historic Preservation Office (SHPO) have concurred with these recommendations.

Detailed survey along the final centerline and access road locations for the transmission line would be necessary to fully evaluate presence or absence of historical or archaeological sites. For example, three historic properties on private lands along U.S. 2, the Schrieber homestead, the Wade Ranch and the Mannicke School, contain buildings which have been recommended as eligible for listing on the NRHP (Roeder and Heath, 1981), but have not been fully recorded or evaluated by the SHPO. KNF records also indicate that the historical Swamp Creek ranger station site and portions of the railroad used by the Libby Logging Company and the J. Neils Logging Company could be crossed by Alternative 6.

Recorded Cultural Resources

Site 24LN942 is a collapsed log cabin with remnants of a shed-style roof, located above Libby Creek. It is within the boundaries of the Libby Creek adit site. Features associated with the cabin include a trail connecting it to a two-track road, large stumps and cut logs, and a filled depression. The site is in poor condition due to natural deterioration. No additional substantive information can be gained from this site beyond that obtained during initial recording and photographic documentation.

Site 24LN943, located above Libby Creek, consists of four features—a collapsed, wood-frame residence, a collapsed pole-frame shed, a collapsed outhouse, and a dump. Based on the artifacts present at the site, it appears to be a logging camp last used in the 1950s. The site is in poor condition, and due to the lack of documentation for short-term logging camps, no further information can be gained from this site to that obtained during the initial recording and photographic documentation.

SOUND

Natural sound sources include wind, wildlife, waterflow, thunder, and wind-induced noise, such as the rustling of foliage. Other sound sources include vehicles, such as trucks or airplanes, and man. The overall contribution from human activities, however, is small, and the predominant sound sources are natural.

Measured average daytime, nighttime and combined daytime and nighttime sound levels (L_d, L_n and L_{dn}) at two monitoring locations are presented in Table 3-34. Nighttime sound levels are 4 to 12 decibels [dB(A)] lower than daytime levels, due to cessation of many human related activities. Wind conditions during the monitoring period were low, less than 15 mph, eliminating wind as a significant sound source.

Table 3-34. Summary of ambient sound measurements.†

Measurement period	Little Cherry Creek	Ramsey Creek
Midweek		
Day (L_d)	39.0	41.3
Night (L_n)	35.5	28.8
L_{dn}	42.6	40.5
Weekend		
Day(L_d)	28.6	40.1
Night (L_n)	22.7	31.3
L_{dn}	30.6	40.6

Source: Woodward-Clyde Consultants, Inc. 1989a. pp. S-1 to S-3.
†Equivalent sound level (L_{eq}) expressed as dB(A) re 20 µPa.

4

CONSEQUENCES OF THE PROPOSAL AND ALTERNATIVES

THIS chapter discusses the anticipated impacts of the seven alternatives identified for the Montanore Project as described in Chapter 2. The seven alternatives evaluated are—

- Alternative 1–Noranda's proposal;
- Alternative 2–Noranda's mine proposal with modifications;
- Alternative 3–Noranda's mine proposal with modification and with water treatment;
- Alternative 4–Noranda's transmission line proposal with modifications;
- Alternative 5–North Miller Creek alternative transmission line routing;
- Alternative 6–Swamp Creek alternative transmission line routing; and
- Alternative 7–No action alternative.

Alternatives 2 and 3 for the mine and Alternatives 4, 5 and 6 for the transmission line consist of Noranda's proposal with "mitigating measures", monitoring, or other actions that would be taken to reduce or eliminate the adverse impacts projected. All actions listed as mitigating measures were developed by the agencies and are not proposals by Noranda. These measures may be required by the agencies as a condition of issuance of permits described in Chapter 2.

A separate section at the end of this chapter discusses the need for and reliability of the proposed transmission line.

AIR QUALITY

SUMMARY

All development alternatives would increase ambient concentrations of air pollutants; no established air quality standards, however, would be exceeded. Ambient concentrations of metals in the air from the project area would be less than guideline values adopted by the state of Montana. Visibility in the area of the proposed project would also be affected similarly for all development alternatives. Emission plumes from the Libby Creek and Ramsey Creek adits would not exceed any established air quality visibility criteria . Noranda would implement an air quality monitoring program as a part of Alternative 2 and 3. Projected increases in emissions would not occur under Alternative 7.

ALTERNATIVE 1

Emission Sources

There would be four stationary sources of air pollutants in the proposed project—the Ramsey Creek adit, the Libby Creek adit, the Ramsey Creek plant site, and the tailings pond. Emissions from the Ramsey Creek adit would originate underground in the mine. Sources would include primary crushing, coarse ore conveying, blasting, diesel exhaust, and propane air heaters. Air emissions would be exhausted horizontally, with an expected flow rate of 700,000 cubic feet per minute.

The plant site would contain facilities for handling and grinding the coarse ore from the mine, and for handling the concentrate produced by the mill. Ore transfer by conveyor to a coarse ore stockpile, and wind erosion of the stockpile would be sources of dust emissions. No dust emissions are anticipated from the mill as the material in process would be kept wet. Some dust would be emitted from concentrate handling, but the amount would be minimized by maintaining a high moisture content.

Emissions from the Libby Creek adit would consist of dust from blasting, diesel exhaust, and combustion fumes from propane air heaters. Emissions from the Libby Creek adit would be exhausted vertically, at an expected flow rate of 700,000 cubic feet per minute.

The tailings from the mill would be gravity-fed to the tailings pond at Little Cherry Creek. As the slurry drains, part of the slime surface would dry out becoming a source of fugitive dust, mainly in the summer months.

Dust and diesel exhaust would be emitted to the air as a result of transmission line, access road construction/reconstruction and substation construction. The expected levels of emissions would be small temporary increases and would not affect air quality beyond the construction period.

Emission Estimates

Particulates. Noranda submitted computer modeled air quality information in the air quality permit application (TRC Environmental Consultants, Inc., 1989). Two models were used—the COMPLEX I model and the ISCST model. COMPLEX I was used to estimate impacts from the Ramsey Creek and Libby Creek facilities. In both cases, the model receptor grid included all locations expected to have high concentrations of particulates from these two sources. Receptors also were located along the boundary of the Cabinet Mountains Wilderness due to the sensitivity of its Class I airshed. Receptor

grids are shown in the air quality permit application (TRC Environmental Consultants, Inc., 1989). For the tailings pond, particulate impacts were estimated using the ISCST model. The models have been approved by the Environmental Protection Agency and the Montana Air Quality Bureau.

All model runs predicted particulate (PM-10) concentrations well below federal and Montana ambient air standards (Table 4-1). Emissions are measured in micrograms per cubic meter of air ($\mu g/m^3$). Highest increased particulate concentrations (24-hour) would occur near the plant site outside the wilderness (33.6 $\mu g/m^3$). However, when added to the background concentration of 35.0 $\mu g/m^3$, the increased particulates would result in a maximum 24-hour concentration level during mining of 68.6 $\mu g/m^3$, less than one half of the applicable standard of 150 $\mu g/m^3$.

The predicted concentrations assumes paving of the main access road (Bear Creek Road) and does not consider other pre-operational construction activities. Emissions, especially particulates, would be higher during the construction phase than during the operations phase. Prior to road paving, Noranda would be required to control particulate emissions through water and other control techniques. The agencies would monitor Noranda's control practices through inspection and visual observations.

Particulate emissions in pristine areas such as the Cabinet Mountains Wilderness are covered by the ambient air standards, and by standards establishing the maximum allowable increase (increment) above the background concentration (i.e., Prevention of Significant Deterioration [PSD] standards. Although the PSD standards would not be applicable to the Montanore Project, many of the specific PSD requirements would be met. These include pre- and post-construction ambient monitoring, computer simulation modeling of emission impacts, an analysis of visibility impacts, and the application of Best Available Control Technology (BACT) to emission sources. The maximum modeled particulate impacts would be equivalent to 90 percent of the 24-hour increment and 13 percent of the annual increment. These are below the PSD levels for Class I (wilderness) areas.

Table 4-1. Maximum predicted particulate (PM-10) concentrations and applicable standards.

Area	Averaging time	Predicted concentration	Background concentration	Predicted plus background	Applicable standard
		$\mu g/m^3$			
Plant site	Annual	3.8	10.6	14.4	50
	24-hour	33.6	35.0	68.6	150
Libby Creek adit	Annual	0.7	10.6	11.3	50
	24-hour	5.3	35.0	40.3	150
Cabinet Mountains Wilderness					
(from plant site)	Annual	0.7	10.6	11.3	50
	24-hour	9.0	35.0	44.0	150
(from Libby Ck. adit)	Annual	<0.1	10.6	10.6	50
	24-hour	0.8	35.0	35.8	150
Tailings impoundment area	Annual	4.0	10.2	14.2	50
	24-hour	8.2	28.0	36.2	150

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-10.

Nitrogen Oxides

Ramsey Creek. To simplify the modeling of nitrogen oxide emissions from the Ramsey Creek adit, annual impacts were modeled assuming 100 percent conversion of all nitrogen oxides to nitrogen dioxide (NO_2), a method that overestimates impacts over the course of a year. On this basis, the annual NO_2 level was 10.9 μg/m³, predicted along the northern edge of the permit boundary (Table 4-2).

The federal ambient air standard for NO_2 applies only to annual average concentrations; Montana has a 1-hour standard. In modeling the maximum 1-hour impact, the maximum NO_2 concentration predicted by modeling was modified to account for partial conversion of other NO_2 compounds to NO_2, using a procedure recommended by the EPA in its modeling guidelines (EPA, 1986). The maximum predicted 1-hour NO_2 emission level is 225.3 μg/m³ (Table 4-2). A separate model run was made to predict impacts in the Cabinet Mountains Wilderness. The maximum predicted annual concentration at any receptor in the wilderness is 1.9 μg/m³.

Libby Creek. Using the same methods discussed for Ramsey Creek, the maximum predicted average annual NO_2 emission levels in Libby Creek is 18.2 μg/m³ at a receptor north-northeast of the Libby Creek portal on the permit boundary. The predicted 1-hour maximum NO_2 concentration is 250.8 μg/m³ (Table 4-2). The predicted annual concentration in the Cabinet Mountains Wilderness is 0.7 μg/m³. All predicted emission levels are below standards.

Carbon Monoxide

As with nitrogen dioxide, the Libby Creek and Ramsey Creek adits would be the primary carbon monoxide sources for the proposed project. For both sources, modeling was performed using the same model, COMPLEX I, and the same receptor array as was used for particulates and NO_2. Although the impact prediction method for NO_2 and carbon monoxide (CO) is the same, there are no background concentrations available from baseline monitoring data or other sources. The predicted concentrations are very small compared to ambient air standards, so the project's emissions would not likely cause or contribute to an air quality problem with respect to CO (Table 4-3).

Lead

Predicted 24-hour maximum lead concentrations are 0.04 μg/m³ at the tailings pond and 0.2 μg/m³ at the Ramsey Creek plant. These concentrations are higher than a monthly average would be, but are still lower than the quarterly average standard of 1.5 μg/m³.

Table 4-2. Predicted nitrogen dioxide concentrations and applicable standards.

Area	Averaging time	Predicted concentration (μg/m³)	Background concentration (μg/m³)	Predicted plus background (μg/m³)	Applicable standard (μg/m³)
Plant site					
	Annual	10.9	3.2	14.1	100
	1-hour	225.3	92.5	317.7	566
Libby Creek adit					
	Annual	18.2	3.2	21.4	100
	1-hour	250.8	92.5	343.2	566

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-13.

Table 4-3. Predicted concentrations and applicable standards for carbon monoxide.

Location	Averaging time	Predicted concentration (µg/m³)	Montana standard (µg/m³)
Ramsey Creek	8-hour	153	10,000
	1-hour	354	26,437
Libby Creek	8-hour	560	10,000
	1-hour	1,134	26,437

Source: TRC Environmental Consultants, Inc. 1989. V. 1, pp. 6-14.

Non-criteria Pollutants

Non-criteria pollutants are those which are regulated, but have no ambient air standard. The Montana Air Quality Bureau has adopted guideline concentration values for a number of metals—arsenic, antimony, cadmium, chromium, zinc, copper and iron. For all pollutants in this category, modeled concentrations are less than the adopted guidelines.

Visibility

An estimate of the proposed project's effect on visibility from and within the Cabinet Mountains Wilderness was made following the procedures of the EPA document, *Workbook for Plume Visual Impact Screening and Analysis* (EPA, 1988b). These procedures incorporate a staged analysis approach. An initial screening procedure, referred to as Level 1, uses assumptions that tend to overestimate the impacts, but is relatively simple to perform. If the Level 1 result shows a significant impact, a Level 2 analysis is performed. The Level 2 procedure uses inputs based on local meteorology and source operation, rather than worst-case assumptions, and therefore produces more realistic impact estimates. Details on the model, input data and results are contained in Noranda's air quality application (TRC Environmental Consultants, Inc., 1990b) and a visibility impact assessment report (TRC Environmental Consultants, Inc., 1990c). Modeling procedures are described in greater detail in Chapter 6.

Modeling results for Level 1 visibility screening showed no significant impact within the wilderness due to emissions from the tailings pond. Emissions from both the Ramsey Creek and Libby Creek adits, however, were predicted to cause impacts within the wilderness. Impacts outside the wilderness were not considered, as no integral vistas have been designated. The more sensitive Level 2 analysis of project emissions predicted no significant impacts for any source for any view within the Cabinet Mountains Wilderness (see Chapter 6 for description of analysis).

Plume Interaction

The Ramsey Creek adit, the Libby Creek adit, and the tailings pond were modeled to estimate combined particulates emission impacts. The predicted maximum particulate concentrations from all sources are not expected to be more than those modeled for the Ramsey Creek facilities alone (Table 4-4). Nitrogen oxides emissions from Libby Creek and Ramsey Creek were similarly modeled. Model results indicate that combined emissions would not be greater than those predicted from the Libby Creek adit alone. Based on these results, little plume interaction would be expected to occur in the area.

Emissions impacts to the town of Libby were predicted to determine the estimated maximum PM-10 concentrations. The maximum annual average PM-10 concentration at Libby was predicted to increase 0.001 $\mu g/m^3$, and maximum predicted 24-hour increase was 0.01 $\mu g/m^3$. Both predicted impacts are much smaller than the PM-10 "significant" concentrations limit standards of 1.0 $\mu g/m^3$ (annual) and 5.0 $\mu g/m^3$ (24-hour).

Secondary Impacts

Air quality impacts from growth of population could occur in Libby. It is estimated that the peak

Table 4-4. Projected combined particulate concentrations and applicable standards.

Pollutant	Averaging time	Predicted concentration	Background concentration	Predicted plus background	Applicable standard
		μg/m³			
PM-10	Annual	3.8	10.6	14.4	50
	24-hour	33.6	35.0	68.6	150
Nitrogen dioxide	Annual	18.3	3.2	21.5	100
	1-hour	250.8	92.5	343.3	566

Source: TRC Environmental Consultants, Inc. 1990a. Addendum 1, pp. 13-15.

population increase would occur in 1993 and the development would cause an additional 411 people to move to Libby, or rural areas near Libby. To accommodate this increase in population, the number of housing units would also increase (see Socio-economics in this chapter). Assuming that the population growth is directly related to emissions from wood burning fireplaces and stoves and motor vehicle traffic, it is estimated that the resulting PM-10 average concentration in Libby would increase from 64 mg/m³ to 67 mg/m³ and the maximum 24-hour value would increase from 256 mg/m³ to 270 mg/m³ without any air pollution mitigation.

Although direct impacts from the proposed project would be small, secondary impacts related to population growth might cause increased costs to the local government. This potential impact would be addressed through the Hard Rock Mining Impact Plan described in Chapter 1 and the socioeconomic sections in Chapter 4.

The Libby Air Quality Advisory Committee is developing an air quality compliance plan to reduce PM-10 levels in Libby. Measures being considered include wood burning restrictions during poor dispersion conditions, requiring all new wood stoves to be certified clean burning, using road sanding material with fewer fine-textured particles, paving unpaved roads, cleaning and sweeping streets, reducing sanding in the winter, and reducing emissions from the Champion International operations.

Air Emissions Control Measures

Noranda has identified equipment and facility practices to control or minimize air emissions (Table 4-5). The control measures proposed include—

- watering and revegetating during construction activities;
- using proper maintenance practices for diesel equipment and particulate traps to remove particulates;
- using propane fuel rather than wood or oil for space heating;
- installing a high efficiency wet scrubber system to reduce dust from the primary crusher;
- using a high efficiency wet scrubber during ore transfer;
- paving the main access road (from U.S. 2 to the plant site);
- installing sprinklers to keep tailings impoundment material wet; and
- enclosing the rail siding at Libby.

The control efficiencies for each of these measures were estimated (where appropriate) based on experience for similar mines and mills (Table 4-5). The expected major sources of particulates are unpaved roads and the tailings impoundment. Paving the access road would significantly reduce

Table 4-5. **Proposed control equipment and practices—Montanore Project.**

Source/ activity	Pollutant	Type of control equipment/practice	Estimated control efficiency
Construction	TSP/metals	Watering haul roads and work areas	—
		Topsoil storage revegetation	—
		Regulate slash burning	—
Blasting	TSP/metals	Stemming, drill hole size optimization	—
		Rubble watering	—
	NO_2	Control overshooting	—
	SO_2	Control overshooting	—
	CO	Control overshooting	—
Diesel equipment	TSP	Particulate matter trap renewal	—
	NO_2	DITA engines	40%
	SO_2	Low sulfur diesel oil	—
	CO	Frequent tune-ups to manufacturer's specs	—
	HC	Routine fuel delivery and burner system evap. cont. system maintenance	—
Space heating	TSP	Use propane, routine maintenance schedule	—
	NO_2	Maintain near-stoichiometric atmosphere	—
	CO	Maintain near-stoichiometric atmosphere	—
	HC	Routine fuel delivery and burner system Inspection/renewal	—
Primary crushing	TSP/metals	High efficiency wet scrubber	95%
Ore transfer	TSP/metals	High efficiency wet scrubber	95%
Mill	TSP/metals	Fully wet SAG mill	100%
Road dust	TSP	Chip and seal	—
Tailings impoundment	TSP/metals	Sprinklers	50%
Rail siding (Libby)	TSP	Enclosure of operations	—
		Covered conveyor	—
		Haul truck area clean-up	—

Source: TRC Environmental Consultants, Inc. 1989. V.1, pp. 3-4.
TRC Environmental Consultants, Inc. 1990. p. 5.

particulate emissions in the area. The tailings sprinkler system would reduce particulates by an estimated 50 percent.

The proposed control equipment and facility practices are Best Available Control Technology (BACT) and represent reasonable control measures. Proposed interim reclamation plans for many disturbed areas also would reduce fugitive dust emissions. Ambient air quality and meteorological monitoring near the mine/mill and tailings area would be required.

A specific air quality concern is the potential for wind erosion from the tailings impoundment area. If tailings surfaces are allowed to dry, there is a significant potential for wind erosion to occur given the fine texture of tailings material. The impoundment would be designed so that one third of the surface would be completely submerged at all times. A water-sprinkling system would be used to wet exposed surfaces and natural precipitation also would provide some measure of control. The factors noted above, as well as expected meteorological conditions, were used in estimating wind erosion emissions. Even with these controls, it would be expected that some wind erosion would occur during high wind conditions; however, particulate levels should remain well below the applicable ambient air quality standards. The overall efficiency and adequacy of the proposed controls would be evaluated through the periodic review of air quality monitoring data and occasional visual observation of the operation by the agencies.

ALTERNATIVE 2

Noranda would institute the air monitoring program described in detail in Appendix B. Implementation of the monitoring program would ensure emissions levels expected under Alternative 1 are effectively controlled throughout the project life.

In the event that the proposed erosion control measures are determined by the agencies to be inadequate, other wind erosion control measures which could be implemented include—

- establishment of a temporary vegetative cover on portions of the tailings surface and embankment;
- chemical stabilization of some areas;
- upgrading of the sprinkler system to provide more extensive coverage and water availability; and
- development of a detailed sprinkler operating plan which would be frequently updated as the tailings surface expands. (This might include specific record-keeping requirements such as times of sprinkler operation and the amount of water applied and development of a minimum threshold wind speed criteria above which sprinkling might be required.)

ALTERNATIVE 3

Gaseous and particulate emissions which would occur during construction of the percolation ponds would be reduced. Such emissions would be limited and their reduction would not significantly affect air quality. Other impacts would be the same as those described for Alternative 1.

ALTERNATIVES 4, 5 AND 6

With the exception of short term increases in gaseous and particulate emissions during construction, the transmission line operation would not affect air quality.

ALTERNATIVE 7

The increased air emissions from mine construction and operation described under Alternative 1 would not occur. The ambient air quality in the Cabinet Mountains Wilderness would not change.

CUMULATIVE IMPACTS

All alternatives would have similar cumulative impacts. Timber harvesting and timber hauling on unpaved roads would increase particulate emissions. Total estimated particulate emissions from the Montanore Project would be about five percent of the emissions associated with timber harvesting. Environmental assessments of timber sales would evaluate air quality issues prior to sale approval.

The ASARCO Rock Creek project is proposed on the west side of the Cabinet Mountains in the Rock Creek drainage. Emissions sources would be associated with the plant site, tailings impoundment and other surface disturbances. Because the ASARCO operation would be smaller, emissions would be about 50 percent of the emissions associated with the Montanore Project. Although an intake ventilation adit would be located in the Cabinet

Mountains Wilderness, it would not be a source of emissions.

The dominant wind direction at ASARCO's proposed tailings impoundment site is divided equally between up-valley winds and down-valley winds. Wind patterns at ASARCO's proposed plant site are expected to be similar. During down-valley air flows, no cumulative impacts are expected. During up-valley wind direction, dilution of emissions would likely reduce ASARCO's emissions to below detectable levels at Noranda's air monitoring locations.

RESOURCE COMMITMENTS

During construction and operation of the mine, air pollutant concentrations would be higher throughout the project area and in the Cabinet Mountains Wilderness than current levels, but below applicable air quality standards. Following mine closure and successful reclamation, pollutant concentrations would return to pre-mining levels.

GEOLOGY AND GEOTECHNICAL

SUMMARY

Construction of project facilities would alter the existing topography and surface water drainage system at the plant site, the Libby Creek adit site and the tailings impoundment area. Construction of substations and roads would alter the existing surface water drainage in minor ways. The most significant alteration of the existing topography would be the construction of the tailings impoundment. The tailings impoundment would remain as a permanent landform in the lower Little Cherry Creek valley.

Stability analyses indicate the tailings embankment would remain stable even in the event of a maximum credible earthquake. Artesian conditions at the impoundment site would be controlled using a passive pressure relief system. These measures would prevent water uplift pressures from affecting embankment stability.

No landslide areas or areas of slope instability have been identified in the area of the mine, adits, tailings impoundment site and the Sedlak Park substation. Areas of steep, possibly unstable slopes occur along the transmission line routes. Avalanche areas in the Ramsey Creek drainage could pose a hazard to the transmission line. Mining should result in no subsidence of the overlying surface. Areas of the deposit potentially susceptible to subsidence would either not be mined or would include measures to prevent subsidence.

As part of Alternatives 2 and 3, Noranda would institute monitoring designed to evaluate the geotechnical and hydrological conditions near Rock Lake and the Rock Lake Fault. Noranda would be restricted from mining within 200 feet of the Rock Lake Fault and 750 feet of Rock Lake. Noranda would be permitted to mine closer to these areas if agency review of underground studies indicates that narrower avoidance areas would be acceptable. The transmission line alternatives (4, 5, and 6) would have little impact on geological resources. Under Alternative 7, the proposed landscape modifications would not occur.

ALTERNATIVE 1

Topography and Geomorphology

Libby Creek and Ramsey Creek facilities. Construction of surface facilities for the Montanore Project would alter the existing topography and surface drainage system. Existing disturbance at the Libby Creek adit area (19 acres) includes cut-and-fill benches, a temporary waste rock pile, and a percolation pond. The waste rock would eventually be used for construction of the tailings impoundment. At the end of operations, the percolation pond would be filled and waste rock from the bench would be backfilled into the adit for closure. Except for a small bench (less than 3 acres) that would remain following mining operations, the post-mining topography would approximate pre-mining conditions.

The Ramsey Creek portal and plant site (45 acres) also would be constructed using a cut-and-fill sequence with the fill supplemented with waste rock from adit construction. Cut slopes would be benched at 15- to 25-foot intervals. Following operations, the mine portal would be backfilled to the approximate original topography. Benches for the mill, electrical substation, and thickener would remain. All drainage and diversion structures used during the operational period at the mill site would be removed and the pre-mining drainage restored. Drainage on the remaining fill material would be riprapped if necessary to control erosion.

Water disposal and waste rock storage areas. Two percolation ponds and a temporary waste rock pile (about 80 acres) would be constructed adjacent to lower Ramsey Creek. The stockpile site would be reclaimed to its pre-operational topography. If construction requirements do not exceed waste rock production, or if more economical borrow material becomes available, one or more waste rock storage areas would remain.

The water disposal areas would slightly modify the existing hillslope. Each pond would be approximately 280 feet wide with a 25-foot wide berm between the two ponds. The percolation ponds would be stabilized with vegetation during operations. Following operations, the pond areas would be left in their operational configuration.

Tailings impoundment. The most significant alteration of existing topography would be construction of a 595-acre tailings impoundment. The impoundment dam would have a maximum height of 380 feet. The tailings impoundment would remain as a permanent landform following mining operations.

Diversion channel stability. Because the diversion channel would cross a hillslope, channel failure and flooding might occur. The design of the diversion would make overtopping of the channel banks unlikely. However, if the diversion channel were unable to transport the sediment load from upper Little Cherry Creek and adjacent hillslopes, excess sediment would be deposited in the diversion channel, reducing its flow capacity. This condition would eventually lead to overtopping and failure of the permanent diversion channel. Should this occur, flow would probably follow the topographic low between the natural topography and the southern boundary of the tailings pond toward the unnamed tributary of Libby Creek. This would probably result in erosion of the tailings impoundment and transport of tailings into Libby Creek.

The diversion of additional flow into the unnamed tributary of Libby Creek would potentially result in increased erosion and channel down-cutting in the tributary and transport of sediment into Libby Creek. To minimize this potential for erosion in the natural stream channel, rockfilled bars would be constructed perpendicular to the channel at the end of operations.

Transmission line. Construction of the transmission line would result in minor alteration of the existing topography and surface water drainage at structure sites, and roads. Construction of the Sedlak Park

substation might require diversion of Sedlak Creek, although it might be possible to locate this facility to minimize channel disturbance by increasing cut-and-fill construction at the site. Following reclamation at the end of the transmission line's useful life, topography and surface drainage would approximate existing conditions.

Tailings Impoundment Stability

Tailings embankment. The calculated safety factors under static and seismic conditions indicate stability of the starter dam and final tailings embankment exceed the generally accepted minimum values (Morrison-Knudsen Engineers, Inc., 1989a.). The tailings embankment would remain stable during construction and operation even in the event of the Maximum Credible Earthquake (MCE). For this project, the MCE was determined to be an earthquake having a magnitude 7.0 on the Richter Scale originating on the Bull Lake Fault, located about 12 miles west of the impoundment site.

Static and pseudostatic (seismic) stability analyses of the tailings embankment were conducted independently by the agencies, (see Chapter 6 for analysis). This analysis generally concurred with the analysis conducted by Noranda. Chapter 6 discusses the stability analysis methods.

The tailings embankment stability would be enhanced by inclusion of a gravel blanket drain, filter zones, a rockfilled zone, and a limited number of gravel finger drains as proposed by Noranda (see Figure 2-11). The combined action of the blanket drain, filters, rock fill, and finger drains would be to lower the phreatic water surface within the embankment by intercepting seepage, increasing overall impoundment stability.

Tailings embankment foundation. The density of foundation soils under the proposed tailings embankment would be sufficient to preclude the occurrence of liquefaction (loss of soil strength during seismic shaking) in the event of the Maximum Credible Earthquake. The stiffness of the foundation soils would preclude the occurrence of excessive settlements of the embankment foundation.

Artesian ground water conditions have been identified within the area proposed for the tailings embankment and impoundment. Current artesian pressure is low and would not be expected to adversely affect dam stability. Artesian conditions, however, might increase in magnitude during the project life as a result of seepage from the impoundment. This condition would have a detrimental effect on the embankment stability, due to the development of uplift pressures within the embankment foundation, resulting in a loss of embankment or foundation soil strength and possible instability.

Noranda would install a pressure relief system to intercept artesian ground water. The proposed system would consist of a combination of wells and drains beneath the dam. Noranda would submit a system design to the agencies for review and approval prior to construction.

The primary limitation of such a system when applied to the project site is due to the nature of the subsurface soils underlying the proposed impoundment and dam site. Subsurface seepage exiting the impoundment would most likely occur within more granular soils (sands and gravels) of relatively high permeability, rather than within fine grained soils (silts and clays) having relatively low permeability. However, the nature of the subsurface soil profile at the site is such that the granular soils exist in "lenses", separated by finer grained soils. These lenses are generally not continuous in the lateral direction for very long distances. Therefore a clearly definable seepage path(s) between the impoundment and the areas downstream of the embankment cannot be assigned to specific lenses of more granular soils, due to their discontinuous nature. Until the actual paths of the tailings seepage are manifested during facility operation, it would be very difficult to identify the most effective pattern of wells needed to intercept seepage through the well system. Additionally, it would be difficult to select

the appropriate completion zone to monitor the effectiveness of the system during installation of ground water monitoring wells.

Subsidence

Underground mining disrupts the established equilibrium, and changes the magnitude and direction of the stress field in surrounding rocks. As stress increases exceed the strength of the local rock mass, a long period of fracturing will continue until the rock mass again reaches equilibrium. The reaction of the rock mass to mine-induced stress by fracturing is commonly called destressing, and the fractured, or destressed rock mass is referred to as the zone of decompression.

Although destressing always occurs, the effects are controlled during mining by underground support systems, such as rock bolting or pillars. The effect of equilibration is to ultimately close the mine openings (convergence). As destressing and convergence progresses, the fractured overhead rock collapses into the opening and expands in volume by incorporating void spaces in the accumulated rubble, a process referred to as bulking, or swell. The collapse will continue until the caving is stopped by expansion of the fractured rock, when mining-induced changes in the stress field approach equilibrium, by interception of more competent rock above the caving; or by subsidence at the ground surface. Even if the collapse stops in the subsurface, rock fracturing can continue above the collapsed zone. The zone of decompression has the potential to intercept water-bearing structures, and is capable of impacting overlying surface waters and the local ground water system.

The potential for causing subsidence of the ground surface overlying the mine is discussed below. The potential effects on the surface and ground waters in the mine area are presented under Surface Water Hydrology and Ground Water Hydrology, respectively.

Subsidence is the surface expression that results from the collapse of underground openings, such as those created by mining. The surface expression of subsidence might not be visible by casual observation, or it could be seen as depressions, open fractures, pits, troughs, domes, or thrust faults.

The potential for subsidence is a direct relationship between the overburden (rock overlying ore) depth and the height of the mined area. In general, the larger the ratio of overburden to the mining zone, the lower the potential for surface subsidence. For example, there is less potential for subsidence in an area where the overburden thickness is 1,000 feet thick as compared to 100 feet thick, assuming both areas have a 50-foot mining zone. In the former case, bulking of the collapsed rock should stop the collapse long before it reaches the surface. In the latter case, bulking may not be sufficient to stop the collapse and surface subsidence might occur.

Typically, the maximum height of collapse is three to five times the thickness of the mining zone. In rare instances, maximum height of collapse of ten times the thickness of the mining zone has occurred (Piggot and Eynon, 1977). The overburden thickness of the Montanore deposit varies from 0 feet at the outcrop to 3,600 feet or more near St. Paul Lake. Overburden averages over 2,000 feet thick over most of the deposit. The mining zone thickness ranges from about 15 feet to over 100 feet. The mineralization is present as two discrete layers over much of the deposit. This analysis assumes that the mineralization is in a single layer and is representative of the room-and-pillar height. This analysis also assumes that there would be complete collapse of the underground workings.

Figure 4-1 presents an outline of the area overlying the deposit where the overburden to ore thickness ratio is 10:1 or less. This area, near the mineralized outcrop adjacent to Rock Lake, would be potentially susceptible to subsidence if it were mined. Noranda has proposed avoiding this area (see Figure 2-8).

The remainder of the deposit appears to have little or no potential for surface subsidence, even assuming total collapse of the mine workings. The mining

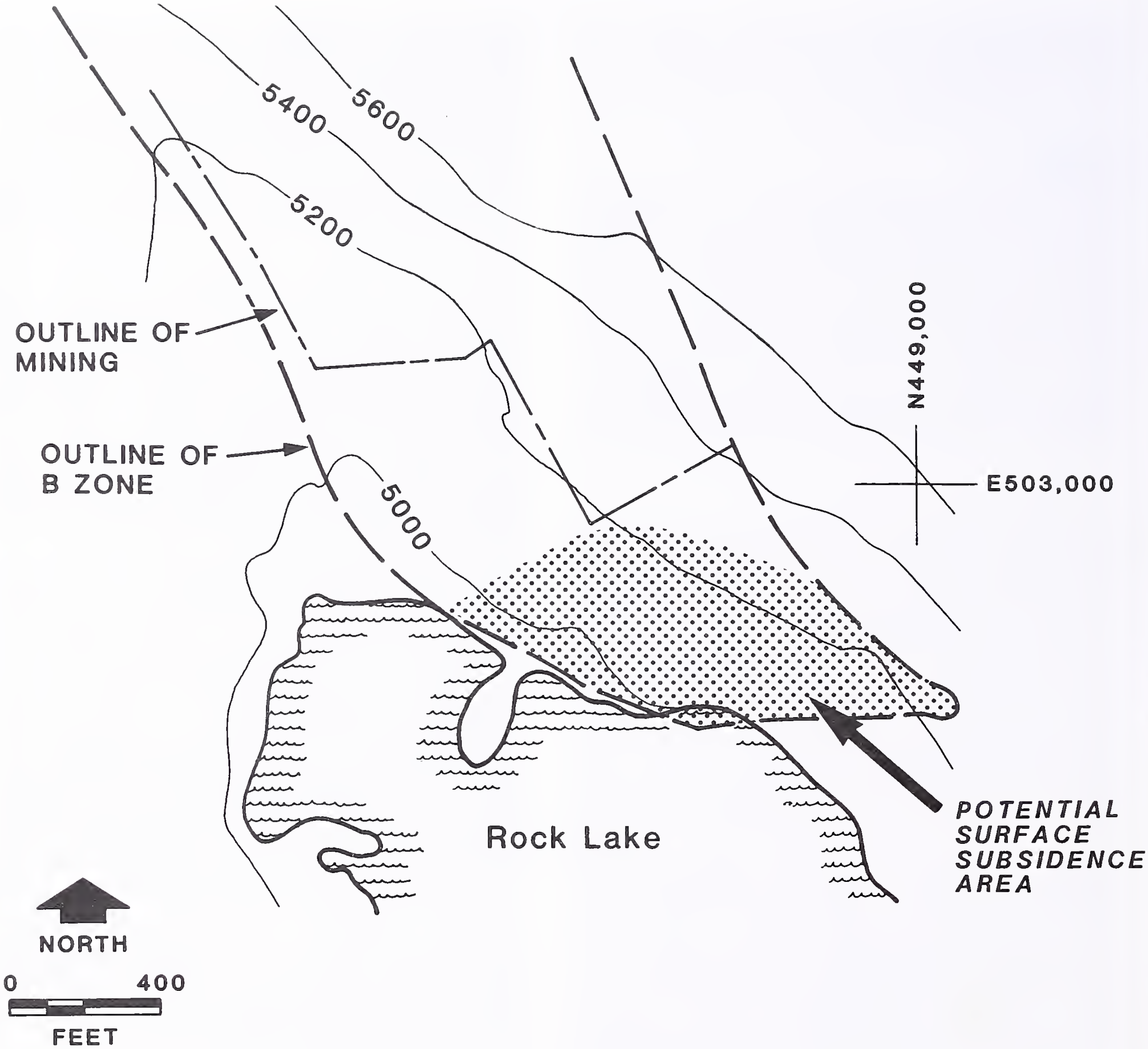


FIGURE 4-1.

POTENTIAL SURFACE SUBSIDENCE AREA

zone over the remainder of the deposit is too thin with respect to the overburden thickness to result in surface expression of subsidence.

Landslides, Slope Stability, and Avalanches

No landslide areas or areas of slope instability have been identified in the area of the mine, adits, tailings impoundment site and the Sedlak Park substation. Localized slope failures might result from road cuts associated with new road construction. Should slope failures in road cuts occur, they would have to be evaluated and mitigated on a case-by-case basis.

Avalanche areas in the Ramsey Creek and upper Libby Creek drainages have been identified. In Ramsey Creek, no avalanche chutes were identified at the Ramsey Creek plant site. A short avalanche chute, occurring near the Ramsey Creek adit, should not affect operations. Avalanches may pose a hazard to the transmission line, near the mouth of Ramsey Creek. Poles would be located to avoid avalanche chutes, but wind blasts caused by avalanches could knock the line out of service. Access roads to the plant site and to the Libby Creek adit also would be susceptible to avalanches originating on the north side of the valley. No other avalanche hazards are known to exist outside these drainages.

Geologic Resources

The ore body comprises a currently estimated 140 million tons, averaging 2.1 ounces of silver per ton and 0.78 percent (~15 pounds per ton) copper. Actual reserves in the deposit to which Noranda has a valid right to mine may be higher or lower than the estimated amount. The Montanore Project would remove 60 to 70 percent of the ore. The remaining 30 to 40 percent would remain in pillars to provide structural support to the mine workings. The ability to recover the remaining ore would depend on metal prices and the structural modifications necessary to mine the pillars.

Besides the Montanore Project ore body, the project area contains mineral resources, such as silver, lead, zinc and gold, which have been mined from numerous small underground mines and placer operations in the past. These resources are primarily located in the higher elevations in the Cabinet Mountains and would not be affected by the proposed operations. Although some of these claims lie within the boundary of the Cabinet Mountains Wilderness, most are outside. While exploration and development of these deposits might be technically feasible, the Montanore Project, while in operation, might preclude such activities because of grizzly bear habitat limitations. A Biological Assessment for all future mineral activities would be required by the KNF prior to approval.

Placer gold has been mined at lower elevations from unconsolidated valley fill deposits along Libby Creek and tributary drainages. Some placer mining, primarily recreational, continues along these drainages today. Except for the construction of the Little Cherry Creek tailings impoundment, the proposed mining operations would not affect the long-term availability of the remaining known placer deposits in the project area. It is uncertain whether economically recoverable placer deposits exist beneath the tailings impoundment site. The only placer mining known to occur in the Little Cherry Creek drainage was located near the confluence with Libby Creek, where gold deposits are covered with thick fill, limiting economic recovery potential (Johns, 1970). If placer deposits exist in the Little Cherry Creek alluvium or in the buried valley deposits, the tailings impoundment would bury these deposits and eliminate the potential for recovery.

ALTERNATIVE 2

Noranda would construct the rockfill bars associated with the Little Cherry Creek diversion during construction of the diversion channel. These bars would be located within the diversion channel, upstream of the connection to the existing natural channel. The rockfill bars would consist of dumped rockfill berms with a nominal height of about four feet, oriented nearly perpendicular to the centerline of

the diversion channel. These bars would reduce sediment transport to Little Cherry Creek and increase channel stability.

Noranda would institute the tailings dam and impoundment monitoring program described in detail in Appendix B. This program is designed to evaluate the stability of the tailings dam throughout the life of the project.

ALTERNATIVE 3

Alternative water treatment would not alter geologic impacts described in Alternative 2.

ALTERNATIVE 4

Location and construction of the Sedlak Park substation to avoid rerouting or disturbance adjacent to Sedlak Creek would result in less effect on surface water drainage. The success of this measure would depend on final engineering survey and substation design. No other impacts would occur from transmission line construction.

ALTERNATIVES 5 AND 6

Selection of an alternative transmission line route would not alter the geological impacts of the mine, adit or tailings impoundment described in Alternative 1. Impacts at the Sedlak Park substation under Alternatives 5 and 6 would be identical to those of Alternative 4.

ALTERNATIVE 7

If the proposed permit is denied, the effects discussed in Alternatives 1 and 2 would not occur. Potential acid generating materials would not be brought to the surface nor would potential acid generating materials be placed in an oxidizing environment underground. One hundred million tons of silver and copper ore would remain in place as pillars.

CUMULATIVE IMPACTS

Both Noranda's Montanore Project and ASARCO's Rock Creek project would mine strata-bound copper and silver deposits from metasedimentary rock. Estimated mineable reserves for the two projects total 200 million tons of ore.

RESOURCE COMMITMENTS

Assuming 70 percent recovery, 100 million tons of ore would be removed by the Montanore Project, with about 40 million tons of ore left for structural support of the mine workings. Actual reserves in the deposit to which Noranda has a valid right to mine may be higher or lower than the estimated amount. Assuming a recovery rate of 70 percent, 206 million ounces of silver and 735,000 tons of copper would be extracted and processed. Other metals in the ore could not be economically recovered. Any precious metals in the alluvium which would be covered by the tailings impoundment would be permanently lost.

SURFACE WATER HYDROLOGY

SUMMARY

Under Alternative 1, surface disturbances associated with the Montanore Project would affect about 1,225 acres in the Libby Creek and Fisher River watersheds. Potential adverse effects from surface disturbances (increased runoff and erosion, and increased sediment loading in Libby Creek or the Fisher Creek) would be reduced through implementation of runoff and sediment control practices prior to facility construction.

The proposed avoidance distance for Rock Lake should be sufficient to prevent drainage of the lake waters. It is possible, however, that fracturing within the zone of decompression would intercept

ground water systems currently discharging to the lake. The 100-foot avoidance distance from the fault might not be sufficient to prevent mine-induced fracturing from intercepting water flow along the Rock Lake Fault.

No surface water withdrawals or direct discharges to receiving streams are proposed. Seepage from the tailings impoundment and excess water discharge to the percolation ponds would eventually reach Libby Creek. As a result of this discharge, streamflow in area streams would increase. During operations, the maximum projected increase would be greatest under low flow conditions, ranging from a seven percent increase in streamflow in upper Libby Creek to a five percent increase in Libby Creek below Hoodoo Creek. Post operations, the projected increase would be a 2.3 percent increase below Little Cherry Creek and a 1.5 percent increase below Hoodoo Creek. Under average flow conditions, the projected increases would be less than one percent at the same locations during and following operations.

Discharges would alter the water quality in Libby Creek by increasing the concentrations of total dissolved solids, nutrients and metals. The greatest effect would occur under low flow conditions when the dilution capacity of Libby Creek would be less. During initial mine development (two to three years after initiation of adit construction) and prior to mill operation, discharge of excess mine water would violate state surface water quality standards for copper and manganese at low flow conditions. Noranda has committed to undertaking the steps necessary to ensure that surface water quality standards would not be violated. These may include additional grouting, increasing evaporation through sprinkler irrigation, or water treatment. In addition, the agencies may revoke operating permits if water quality standards cannot be maintained.

Under Alternative 1, 2, and 3, Noranda would implement a monitoring program designed to evaluate compliance with applicable regulatory standards. The monitoring program is also designed to develop information on water management, particularly on the quantity and quality of tailings impoundment seepage and mine inflows. A monitoring program has been proposed by Noranda and revised by the agencies. Also under Alternative 2, as part of the final design, Noranda would be required to design and seek agency approval of a detailed water management plan to ensure surface water quality standards are maintained for all phases of the project.

Under Alternative 3, disturbance of 80 acres associated with the percolation ponds would not occur. Water would be treated by either a mechanical treatment or by a wetland. Expected concentrations for ammonia and nitrates/nitrites for all treatment alternatives would exceed ambient water quality levels. Manganese concentrations would also exceed ambient conditions using wetlands and electrocoagulation treatment. Expected concentrations for these parameters would not violate state surface water quality standards.

The three transmission line alternatives (4, 5 and 6) would incorporate use of a helicopter for line stringing, avoiding impacts that would be caused by bulldozer stringing equipment. Using a helicopter would prevent sedimentation impacts at the bulldozer crossings of the Fisher River, Howard Creek, and Libby Creek, where existing bridges would provide access for other construction activities.

Under Alternative 7, no surface disturbance and no increased erosion would occur. Ambient water quality would not be affected.

ALTERNATIVE 1

Runoff and Sedimentation

Mine facilities construction and operation. Construction and operation of the mine and associated facilities would disturb about 1,225 acres in the Libby Creek and Fisher River watersheds. If not controlled, the removal of existing vegetation and the physical disturbance of the ground surface would result in temporary increases in runoff and erosion during construction and revegetation periods. The transport of sediment into Libby Creek would affect water quality and disrupt existing channel stability.

Noranda's proposed runoff and sediment control practices would reduce the amount of sediment reaching surface water. These practices include diversion of runoff from undisturbed areas, control of runoff and sediment from disturbed areas, and use of vegetation and riprap where necessary (see Sediment Control in Chapter 2).

These practices would also include snow removal and disposal to ensure proper functioning of runoff and sediment control systems. Snow and ice removed from the surface facilities would be deposited in the percolation ponds to prevent uncontrolled release of sediment (possibly containing toxic metals) trapped in snow during removal procedures.

The top of the impoundment would slope toward the northwest at a grade of between 0.5 percent and 1 percent. Runoff would be collected in a permanent diversion ditch at the upper end of the impoundment and diverted into Bear Creek. The diversion ditch would direct flow toward a saddle located along the divide between the Little Cherry Creek and Bear Creek watersheds. From this point, runoff would be discharged as uncontrolled flow down the hillslope and into Bear Creek. This would result in gullying of the hillslope and transport of sediment into Bear Creek.

The downstream face of the tailing dam would form a long (1,140 feet), 3 to 1 slope. During reclamation, Noranda would install benches on 200 to 400-foot intervals. Prior to establishment of vegetation following reclamation, topsoil used in reclamation would be removed by wind and water erosion. Erosion rates on the face of the Little Cherry Creek diversion dam and the two saddle dams would be less because of their shorter slope lengths. Much of the sediment eroded from the impoundment face would be deposited at the base of the impoundment slope. Some sediment would be transported into Little Cherry Creek and into Libby Creek. To mitigate this potential problem, Noranda would riprap the tailings dam crest and upper portions of the dam face. The lower portions of the dam face would still be susceptible to rill erosion and gullying. Noranda would stabilize and revegetate, as necessary, all rills and gullies.

The tailings impoundment would be situated to maximize tailings storage capacity, and to minimize upstream watershed area drainage along the length of the permanent diversion channel. The permanent diversion system, consisting of a dam at the upstream end of the impoundment and the diversion channel, would route surface water around the impoundment. In the design of the diversion, several types of storm events were considered. The diversion channel would be designed to convey maximum probable runoff occurring during a 6-hour, localized storm. Because of the expected flow velocities, the diversion channel would be riprapped to minimize channel erosion. The long-term stability of the riprap would be evaluated at the completion of operation to ensure adequate permanent erosion control. The diversion channel would be inspected regularly during its 16-year operational life.

The amount of sediment reaching Libby Creek would depend on weather conditions during project construction (primarily amount and intensity of precipitation) and on the efficacy of Noranda's

proposed runoff and sediment control practices. These practices would prevent total suspended solid concentrations from exceeding the 25 mg/L criterion established by the Montana Department of Health and Environmental Sciences (DHES) as being "very protective" of cold water fisheries habitat.

Transmission line stream crossings. All alternative routes cross the Fisher River and its floodplain (Table 4-6). Channel movement would affect the stability of structures located too near the river, although Noranda and the agencies would exercise caution when siting structures near the river. Still, construction of the transmission line can be expected to result in minor increased sediment production during construction and revegetation periods.

All alternatives would cross Libby Creek and Howard Creek north of Howard Lake. Existing bridges are expected to provide crossings for most construction vehicles. Use of existing bridges would avoid most sediment production.

All alternatives cross Ramsey Creek at a location where there is no existing bridge. This might require a temporary stream crossing during construction and result in sediment entering the stream. Noranda would work with the agencies to determine the best crossing location and method to minimize increased sediment production.

Alternative 1 would cross five perennial streams, including the Fisher River. During construction, small amounts of sediment would be released into these streams. Noranda has committed to use appropriate stream crossing methods as determined by a field review with the agencies (see Draft Environmental Specifications for the 230-kV Transmission Line, Appendix F).

In the vicinity of U.S. 2 and the Fisher River, two or three transmission line structures would be located in a 200-foot wide strip of land between the Fisher River and the Champion haul road. About 1,400 feet of new road on 60 percent slopes above the river would be needed to provide access to the structures. These roads would have a moderate potential to introduce sediment to the river. Sediment levels also would increase for a short time if line stringing

Table 4-6. Perennial stream crossings by construction vehicles along transmission line alignment alternatives.

Stream	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Fisher River	∅	∅	∅	∅
Brulee Creek	⊗	⊗	⊗	×
Schrieber Creek	⊗	⊗	⊗	×
Howard Creek	×	×	×	×
Libby Creek	×	×	×	×
Ramsey Creek	∅	∅	∅	∅
Miller Creek	×	×	⊗	⊗

Source: Noranda Minerals Corp. 1989c.
⊗ = stream not crossed by alternative
∅ = stream crossed at location where use of existing crossings by construction equipment would not be practical, new crossing may be required
× = stream would be crossed by construction equipment using existing nearby bridge and road.

activities require crossing the river.

As the route turns up the Miller Creek drainage, one span would be located within 200 feet of Miller Creek. The main Miller Creek road is located between the proposed transmission line and the creek Few new disturbances would be expected and little sediment would be expected to reach Miller Creek in this area during construction. Minor sedimentation would occur during stringing across Howard, Libby, and Ramsey creeks.

Construction and operation of the Ramsey Creek substation would not affect water quality, due to substation design and drainage controls proposed at the mine site. Sedlak Creek might be rerouted around the new substation site at Sedlak Park. Construction activities may introduce small amounts of sediment into the Fisher River from this intermittent stream.

Floodplains

All transmission line routes cross areas designated by the Montana Board of Natural Resources and Conservation and mapped by the U.S. Department of Housing and Urban Development (1980) as 100-year floodplains. Within the study area, floodplains have been mapped along the Fisher River, Miller Creek, Libby Creek, and Ramsey Creek. Table 4-7 indicates the estimated number of structures (transmission line poles) within the designated 100-year floodplain. Channel movement of the Fisher River caused by flooding could affect structure stability and would require proper foundation design and structure location to minimize possible effects. Noranda would be required to obtain a permit from the Lincoln County Disaster and Emergency Services coordinator to construct structures within any designated floodplain. Noranda must show that the proposed structures minimize the potential for obstructing streams and rivers.

The plant site is near a designated 100-year floodplain in upper Ramsey Creek. As with the transmission line, Noranda must show that the proposed plant design minimizes the potential for obstructing Ramsey Creek if the floodplain would be affected by the plant.

Wilderness Lakes

There are several lakes located above and adjacent to the underground mine area, including Rock Lake, St. Paul Lake, and Libby Lakes. Rock Lake is situated along the Rock Lake Fault, and may be hydraulically connected to the fault. In addition, the lake is adjacent to the ore outcrop at the southern end of the deposit. Mining adjacent to Rock Lake, or within the fault zone in this area, could intercept shallow ground water and affect lake levels. Interception may directly drain surface water from the lake or affect ground water systems currently recharging the lake. As a result, water levels in the lake and surface water outflow from the lake might be reduced.

To prevent these effects, Noranda would maintain a minimum mining distance of 500 feet horizontally and vertically from the lake (Figure 2-8). This distance would be maintained unless underground studies indicate that mining can occur closer to the lake without adverse effects. Noranda also would maintain a minimum mining distance of 100 feet from the Rock Lake Fault to isolate the mine workings from water stored in the fault. Hydrologic

Table 4-7. Estimated number of structures on designated 100-year floodplains.

Alternative	Structures within 100-year flood boundaries
1	3
4	3
5	3
6	6

Source: U.S. Department of Housing and Urban Development. 1980. National Flood Insurance Program, Flood Insurance Rate Map. Lincoln County, Montana (unincorporated areas).

studies would be conducted to determine if a narrower avoidance distance could be achieved. These studies would include drilling into the fault zone to determine hydraulic conductivities and transmissivities of the fault and transition zones, the fault and transition zone widths, and water pressures in the fault and transition zones. Noranda has developed a monitoring program to detect and evaluate changes in lake water levels.

The proposed avoidance distance for the lake should be sufficient to prevent drainage of the lake waters. It is possible, however, that fracturing within the zone of decompression would intercept ground water systems currently discharging to the lake. The 100-foot avoidance distance from the fault might not be sufficient to prevent mine-induced fracturing from intercepting water flow along the Rock Lake Fault. Ground water recharge to Rock Lake might also be affected (see Ground Water Hydrology section).

St. Paul Lake is also situated along the Rock Lake Fault. It is located on the northwest edge of the ore deposit, where the mining zone is over 3,000 feet below ground surface. Because of the depth of the mining zone, it is unlikely that mining would result in direct drainage of the lake or intercept ground water systems recharging the lake. If mining were to intercept the Rock Lake Fault, however, water levels in the lake could be affected.

Libby Lakes are located along the eastern margin of the mine area. The ore body does not outcrop near Libby Lakes and no major faults are associated with the lakes. (The lakes lie west of the Libby Lake Fault trace.) The mining zone is located over 3,000 feet below the ground surface. It is unlikely that mining would affect water levels in these lakes.

Streamflow

Noranda holds temporary permits to appropriate water in Ramsey Creek, Poorman Creek, and Little Cherry Creek. Surface water might be used by the proposed operation. Project water requirements would be provided by using mine water from underground workings, recycling overflow from the tailings thickener, and water supply wells. If the water supply wells are inadequate to meet necessary water requirements, Noranda would use surface water from either Libby or Ramsey creeks. Prior to withdrawal of surface water, Noranda would obtain necessary water rights and permits.

During adit construction and initial mine development, mine water would be pumped to the surface and discharged to ground water near the Libby Creek adit and in lower Ramsey Creek by use of percolation ponds, infiltration trenches, or land application. The excess water disposal system is designed to have a capacity to store or discharge up to 2,000 gpm of excess water. Average inflows into the adits of 392 gpm would occur during adit construction, and 560 gpm would enter the underground workings and require disposal prior to mill operation. (The actual rate of inflow would vary because much of the water would be produced as short-term, high inflows when saturated fractures are first encountered during development) After operations begin, excess mine water would be used in the process circuit, and discharge of excess mine water would not be required.

Adit construction and initial mine development would occur for a three-year period prior to production. Mine inflows would occur only during the later portion of this period. Because of the time necessary for ground water to flow from excess water disposal areas to adjacent streams, and the relatively short period of time during which excess water would be discharged, any resulting increased streamflow in Libby Creek would be short term.

A more long-term increase in streamflow in Libby Creek would result from seepage from the tailings impoundment. Seepage from the tailings impoundment would enter shallow ground water systems discharging to Libby Creek. The seepage rate would increase from 50 gpm during the first year of operations to an estimated 475 gpm when the

impoundment reaches its maximum size during Year 16 of operations.

Noranda would intercept sufficient seepage to ensure water quality standards are maintained in Libby Creek. Noranda anticipates intercepting 10 gpm of seepage water in Year 5 of operations and 195 gpm in Year 16. Noranda's seepage interception system would limit ground water discharge to 280 gpm (assuming tailings water quality is as expected).

Using this quantity of discharge, streamflow increases at affected locations in the study area were projected (Table 4-8). The projected increase would be greatest under low flow conditions, ranging from seven percent on Libby Creek below Little Cherry Creek to five percent on Libby Creek below Hoodoo Creek. Under average flow conditions, the projected increases would be less than one percent. If the operational seepage amounts are greater than (or less than) the amounts used in making the projection, the amount of streamflow increase would change correspondingly.

The projected low flow increase would not affect stream channel stability. The flow increase is relatively small, less than the average annual flow in Libby Creek. In addition, the channel bed and banks are composed primarily of coarse materials (gravel, cobbles, and boulders). Therefore, the Libby Creek stream channel is stable and is not susceptible to changing channel geometry in response to streamflow alterations.

Following the cessation of operations, saturated water levels in the tailings impoundment would drop until steady state conditions are achieved. Seepage through the tailings dam and through the bottom of the impoundment would also decrease as the saturated water levels drop. The tailings impoundment would remain partially saturated as new steady state conditions are established. Under these conditions, total seepage (seepage through the dam and the bottom of the impoundment) is expected to be 75 gpm (Noranda Minerals Corp., 1990).

Using a discharge rate of 75 gpm, post-operational streamflow increases at affected locations in the study area were projected (Table 4-8). Under low flow conditions, the projected flow increases in Libby Creek below Little Cherry Creek and below Hoodoo Creek are about two percent. Under average flow conditions, the projected increases would be less than one-half of one percent.

Table 4-8. Estimated changes in Libby Creek streamflow.

	Low flow (7-day, 10-year)			Average annual flow		
Location	Existing (cfs)	Projected (cfs)	Increase (%)	Existing (cfs)	Projected (cfs)	Increase (%)
During operations (Year 16)						
Libby Creek below Little Cherry Creek	8.7	9.3	7.2	122	122.6	0.5
Libby Creek below Hoodoo Creek	13.4	14.0	4.7	188	188.6	0.3
Post operations						
Libby Creek below Little Cherry Creek	8.7	8.9	2.3	122	122.2	0.2
Libby Creek below Hoodoo Creek	13.4	13.6	1.5	188	188.2	0.1

Source: IMS Inc. 1990.

Surface Water Quality

Noranda's proposed discharge of excess water in the percolation ponds area would enter ground water and ultimately discharge into both Libby and Ramsey creeks. Seepage from the tailings impoundment area would enter ground water and ultimately discharge into Libby Creek. As discussed under Streamflow, Noranda would intercept some tailings impoundment seepage, reducing the amount discharging into Libby Creek. The expected quality of the mine water and tailings water would generally have higher concentrations of most parameters in comparison to ambient stream water quality (Table 4-9 and Table 4-10).

Discharge of mine water in the percolation pond area and seepage from the tailings impoundment would change the water quality in Libby Creek. Changes in ground or surface water quality over ambient (existing) concentrations is prohibited unless the Board of Health and Environmental Sciences determines that the changes are justified as a result of necessary social or economic development and that the changes would not preclude present or anticipated uses of the water resources. The Board of Health and Environmental Sciences, however, is prohibited from approving water quality changes beyond the water quality standards established by regulation (Montana Department of Health and Environmental Sciences, 1990, letter to individuals who submitted written comments on Noranda's petition; on file at DHES).

For ground water, the applicable standards are the primary drinking water standards established by the Environmental Protection Agency under the Safe Drinking Water Act (Table 4-10). Montana has adopted these standards for all ground water in the state (Administrative Rules of Montana §16.20.203 [1]). State surface water standards are a combination of drinking water standards and aquatic life standards (Administrative Rules of Montana §16.20.203 [25]). For some metals, such as arsenic, the standard is lower than the analytical detection limit (the lowest concentration detectable by a laboratory using standard procedures). In such cases, the detection limit is effectively the standard.

Noranda proposes to discharge mine and adit water during the first several years of operation. During the construction phase, Noranda would also discharge mine and adit water to percolation ponds at the Libby Creek adit site and the percolation pond area. Water quality changes associated with these discharges have been estimated using a mass balance loading analysis (see Chapter 6 for methods discussion) which considered both average and low flow conditions at two locations on Libby Creek under four discharge scenarios (Table 4-11 through Table 4-14). The loading analysis assumed there would be no metals attenuation (removal by adhering to soil particles) of metals in the unsaturated zone and instantaneous discharge into the receiving stream. Flow might actually take several decades to reach and

Table 4-9. Expected mine, adit, and tailings water quality.

Parameters	Mine water	Adit water (mg/L)	Tailings water
Total dissolved solids	200	172	202
Ammonia	9.0	9.0	6.9
Nitrate/nitrite	17.3	9.22	12.3
Metals (dissolved)			
Aluminum	<0.1	0.1	0.1
Arsenic	<0.005	<0.005	<0.005
Cadmium	<0.001	<0.001	<0.001
Chromium	—	<0.02	<0.02
Copper	0.073	<0.010	0.025
Iron	—	<0.05	0.06
Lead	<0.01	<0.01	<0.010
Manganese	0.49	<0.02	0.46
Mercury	<0.001	<0.0002	<0.001
Molybdenum	—	<0.05	0.01
Silver	<0.005	<0.001	<0.005
Zinc	0.018	<0.02	<0.035

Source: see Chapter 6 for discussion of expected water quality.

Table 4-10. Montana water quality standards, analytical detection limits, and ambient water quality during low flow conditions at two monitoring stations.

Parameter	Ground water†	Surface water*	Detection limit (mg/L)	Libby Creek (LB 800)‡	Libby Creek (LB 2000)‡
Total dissolved solids	No standard	500	1.0	28	41
Ammonia	No standard	2.2§	0.05	<0.05	<0.05
Nitrate/nitrite	10	10	0.01	0.04	0.03
Aluminum	No standard	No standard	0.1	<0.1	<0.1
Arsenic	0.05	0.00002	0.005	<0.005	<0.005
Cadmium	0.01	0.0003¤	0.0001	0.0006	0.0010
Chromium	0.05	0.011¤	0.02	<0.02	<0.02
Copper	No standard	0.003¤	0.001	<0.001	<0.001
Iron	No standard	0.3	0.05	<0.05	<0.05
Lead	0.05	0.0004¤	0.001	<0.001	<0.001
Manganese	No standard	0.05	0.02	<0.02	<0.02
Mercury	0.002	0.000012	0.0002	<0.0002	<0.0002
Molybdenum	No standard	No standard	0.05	<0.05	<0.05
Silver	0.05	0.00012¤	0.0002	<0.0002	0.0003
Zinc	No standard	0.027¤	0.02	<0.02	<0.02

Sources: †Administrative Rules of Montana §16.20.203 (1);
*Administrative Rules of Montana §16.20.603 (25)
‡Chen-Northern, Inc. 1989. Appendix G. September 1988 sampling. Metals are total recoverable.
§Temperature and pH dependent
¤Hardness dependent; values based on 20 mg/L hardness
NS = no standard

discharge into Libby Creek (see Ground Water Hydrology Section), and metals attenuation might occur prior to discharge. Chapter 6 provides a more detailed discussion on the assumptions used in the loading analysis.

The loading analyses predict that silver and, in one case, mercury concentrations would violate surface water quality standards. These results, however, are solely a function of the analytical limits of detection for silver and mercury. These detection limits, which were higher than the standards, are the values used in the loading analyses. It is possible that surface water quality standards for silver and mercury would not be violated if actual loading concentrations are sufficiently below the analytical limits of detection.

During adit construction (Year 1 of construction), water entering the adits (392 gpm) would be disposed in percolation ponds. Increases would occur in total dissolved solids, and nutrient (ammonia, nitrate, and nitrite) and metal concentrations (Table 4-11). Although expected concentrations of total dissolved solids and nutrients would exceed existing concentrations, applicable standards would not be exceeded. Small concentration increases are projected for two metals—copper and silver—under low flow conditions. The amount of increase projected for the two metals would be small, and, given the natural variability in stream water quality, may not be detectable by surface water quality monitoring.

After the adits are constructed and initial mine development occurs, additional inflows would occur (560 gpm). Expected surface water quality changes in Libby Creek during initial mine development with discharge of adit and mine water is shown in Table 4-12. Total dissolved solids and nutrient concentrations would increase over existing concentrations, but would remain under applicable standards. Increases would occur in copper, manganese and silver concentrations, under both low and average flow conditions. Under low flow conditions, surface water standards would be exceeded (Figure 4-2).

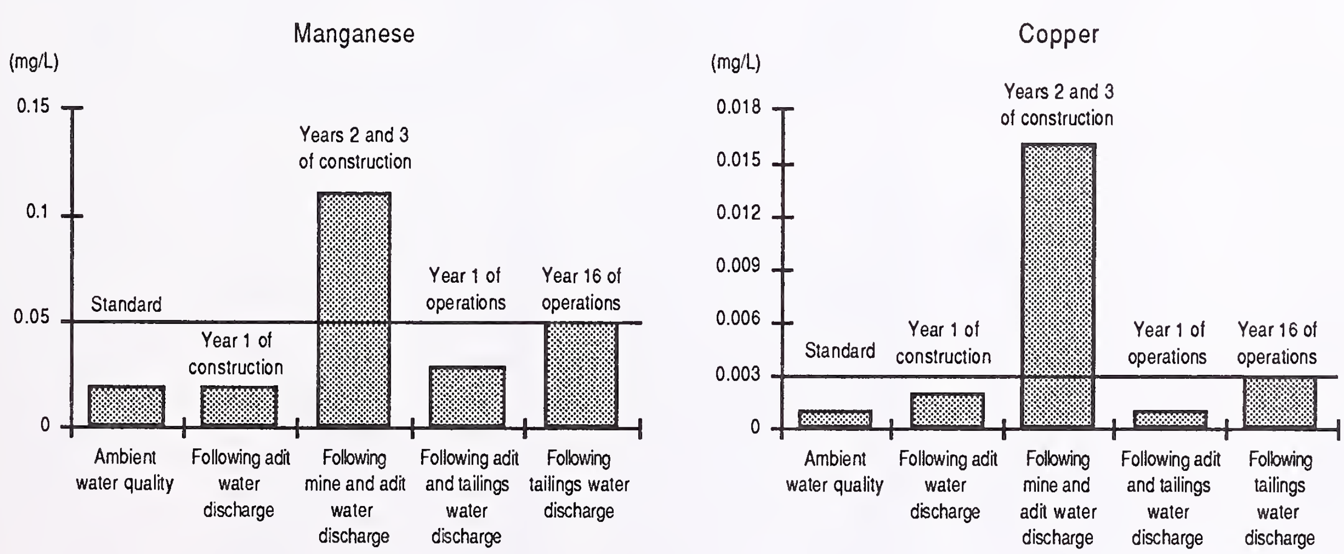
During operations, all mine inflows would be used in the mill. Discharge of some adit inflows would occur during the first several years of operations. Subsequently, adit inflows would be used in the mill. Seepage would also enter ground water from the impoundment and ultimately discharge to Libby Creek. The monitoring station below the impoundment, LB 2000, would be affected by both the impoundment seepage (50 gpm) and percolation pond discharge (69 gpm) in Year 1 of operations.

Under low flow and average conditions, projected increases for total dissolved solids and nutrients would occur (Table 4-13). The expected concentrations would be below applicable standards. Increased concentrations in copper, manganese, and silver would occur only under low flow conditions. Increased concentrations estimated for copper and manganese would be at or below applicable standards.

By Year 16, Noranda anticipates all mine and adit inflows would be used in the mill and seepage from the impoundment would reach 475 gpm. As discussed previously under Streamflow, Noranda proposes to intercept 195 gpm of impoundment seepage to prevent exceeding surface water standards.

Expected surface water quality changes resulting in Libby Creek during Year 16 of operations at station LB 2000 is shown in Table 4-14. Increases in total dissolved solids and nutrients would occur under low flow and average flow conditions; the increases

Figure 4-2. Expected copper and manganese concentrations in Libby Creek during low flow conditions for the four discharge scenarios†



†Ambient water quality for both LB 800 and LB 2000. See Chapter 6 for locations of projected concentrations.

Table 4-11. **Expected surface water quality changes at station LB 800 during adit construction following discharge of only adit water (Year 1 of construction).**

Parameters	Surface water standard	Analytical detection limit§	Low flow: Existing water quality†	Low flow: Projected water quality	Average flow: Existing water quality†	Average flow: Projected water quality
	(mg/L)					
Total dissolved solids	500	1	28	52	17	19
Ammonia	2.2	0.05	<0.05	1.5	0.07	0.2
Nitrate/nitrite	10	0.01	0.04	1.6	0.07	0.2
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	0.0006	<0.001	0.0007	<0.0007
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.002	0.002	<0.002
Iron	0.3	0.05	<0.05	<0.05	0.05	0.05
Lead	0.0004	0.001	<0.001	<0.002	0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.02	<0.02	0.02
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	<0.0002	<0.0003	0.0002	<0.0002
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-12. **Expected surface water quality changes at station LB 800 during initial mine development following discharge of adit and mine water (Years 2 and 3 of construction).**

Parameters	Surface water standard	Analytical detection limit§	Low flow: Existing water quality†	Low flow: Projected water quality	Average flow: Existing water quality†	Average flow: Projected water quality
	(mg/L)					
Total dissolved solids	500	1	28	80	17	23
Ammonia	2.2	0.05	<0.05	<3.0	0.07	0.4
Nitrate/nitrite	10	0.01	0.04	4.6	0.07	0.5
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	0.0006	<0.0007	0.0007	<0.0007
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.016	0.002	<0.003
Iron	0.3	0.05	<0.05	<0.05	0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.004	0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.11	<0.02	<0.03
Mercury	0.000012	0.0002	<0.0002	<0.0004	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	<0.0002	<0.0012	0.0002	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-13. Expected surface water quality changes at station LB 2000 following discharge of adit and tailings water (Year 1 of operations).

Parameters	Surface water standard	Analytical detection limit§	Low flow: Existing water quality†	Low flow: Projected water quality	Average flow: Existing water quality†	Average flow: Projected water quality
	(mg/L)					
Total dissolved solids	500	1	41	45	20	20
Ammonia	2.2	0.05	<0.05	<0.3	0.08	<0.1
Nitrate/nitrite	10	0.01	0.03	0.3	0.06	0.1
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	0.0010	<0.0010	0.0004	<0.0004
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.003	0.002	<0.002
Iron	0.3	0.05	<0.05	<0.05	0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.03	<0.02	<0.02
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0004	0.0003	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-14. Expected surface water quality changes at station LB 2000 following discharge of tailings water (Year 16 of operations).

Parameters	Surface water standard	Analytical detection limit§	Low flow: Existing water quality†	Low flow: Projected water quality	Average flow: Existing water quality†	Average flow: Projected water quality
	(mg/L)					
Total dissolved solids	500	1	41	52	20	21
Ammonia	2.2	0.05	<0.05	<0.5	0.08	<0.1
Nitrate/nitrite	10	0.01	0.03	0.9	0.06	0.1
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	0.0010	<0.0010	0.0004	<0.0004
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.003	0.002	<0.002
Iron	0.3	0.05	<0.05	<0.05	0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.002	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.05	<0.02	<0.02
Mercury	0.000012	0.0002	<0.0002	<0.0003	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0006	0.0003	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

expected would be below applicable standards. Increases in copper, manganese, mercury, and silver concentrations are expected only under low flow conditions. Increased concentrations estimated for copper and manganese would be at applicable standards.

Expected changes in surface water quality following operations would be similar to or less than changes during operations provided that mine water discharge and tailings seepage remain non-acidic. Seepage from the tailings impoundment would decrease after mining is over and analyses indicate the tailings material would not be acid generating. It is not currently possible to project accurately the quantity or quality of post-mining discharge from the mine adits. Noranda, however, would plug the adits if monitoring indicates that the mine water discharge would not meet applicable water quality standards. (See Ground Water Hydrology Section.)

Use of explosives in the mine and reagents in the milling process would affect the quality of water used by the mining operation. Ammonia and nitrate concentrations in the mine and tailings water is the result of explosive use in the mine. Reagents used in the milling process, Potassium Amyl Xanthate, Percol 352, and Methyl Isobutyl Carbinol (MIBC) are soluble, and can be toxic to aquatic life. Noranda proposes to use 140 tons annually of Potassium Amyl Xanthate, and 70 tons annually of Percol 352 and Methyl Isobutyl Carbinol. Specific analyses for these reagents are not available for the draft EIS. The final EIS will include greater discussion of effects of reagents discharge.

Increased potassium concentrations have been detected in the Troy tailings effluent; these may be the result of reagent use in the mill. Bioassays indicate that the Troy tailings water is generally not toxic or deleterious.

Acid Mine Drainage

The ore consists primarily of sulfide minerals. Sulfide minerals also would occur in waste rock from the mine. Chemical analysis of rock samples taken during drilling indicates several toxic metals would be present in the natural rock materials used for fill and in the tailings. These include arsenic, chromium, copper, lead, silver, and zinc. Lead concentrations as high as 28,600 ppm have been identified in samples from the barren zone (Noranda Minerals Corp., 1989b).

If released to the environment, these toxic metals would degrade existing surface and ground water quality, and would adversely affect aquatic life. Releases might occur in two ways—erosion and transport of waste rock and tailings as sediment in surface runoff from the site, and by the release of dissolved metals in acid mine drainage.

The release of significant quantities of sediment from the site is not expected to occur because of required non-point source pollution controls (see Surface Water section). Noranda has analyzed the acid generating potential of several rock types that would be encountered during mining operations (Table 4-15). Information on the acid-generating potential of

Table 4-15. Acid-base potential for various rock types.

Rock material	Neutralization potential†	Acid potential (meq/100 gm)	Acid-base potential†*
Lower Revett	6	<1	+6
Foot wall	8	<1	+8
Raw ore	9	24	-3
Barren zone	2 to 22	9 to 75	-32 to +18
Tailings	8	<1	+8
Libby Creek adit waste rock	—not provided—		+1 to -6

Source: Noranda Minerals Corp. 1989a. p. III-28; KNF project file

†Tons $CaCO_3$/ tons dry material

*Material with values less than -5 are considered acid-generating.

strata immediately overlying the mine workings, some of which would collapse into the workings following operations, is currently not available. Waste rock from the Libby Creek adit has a slight acid-producing potential (Table 4-15). The low potential indicates that tailings disposal and waste rock storage at the site would not be expected to generate acid mine drainage. Waste rock from the Libby Creek adit will continue to be monitored and waste rock from the Ramsey Creek adits would be monitored during construction.

Raw ore would be stored in a coarse ore stockpile at the plant site. Raw ore would be processed in the mill, and the tailings would not be expected to be acid-generating. Most of the waste rock from the barren zone would be disposed in previously mined areas of the underground workings. A small amount (2,500 tons) of waste rock from the barren zone, however, would be brought to the surface to be used in construction of the tailings impoundment dams. This material would be tested and amended with lime if necessary to ensure that acid mine drainage would not occur.

Disposal of the barren zone waste rock at the surface could generate acid mine drainage. Since it is not possible to quantify this release accurately, it is not known if aquatic life or downstream water use would be affected. Use of the barren zone waste rock in the construction of the tailings impoundment dam would make mitigation difficult should significant impacts result.

Monitoring Program

An evaluation of Noranda's proposed surface and ground water monitoring plan is discussed under Ground Water Hydrology later in this chapter.

ALTERNATIVE 2

As part of final design, Noranda would submit for agency review and approval detailed plans on measures necessary to ensure compliance with surface water quality standards during all phases of the project. Plans would include a detailed description of the proposed pressure relief well system and of the system necessary to meet standards during all phases of the project.

Noranda would implement several measures designed to decrease runoff and sediment yield to area streams. Noranda would implement runoff and sediment controls concurrent with construction. This would avoid undue sediment transport during the construction period.

Noranda would maintain runoff and sediment control systems on a monthly basis or after each significant precipitation event. As problems are identified, Noranda would adjust the runoff and sediment control systems to address identified problems.

Construction of rockfill bars concurrent with the diversion channel construction would reduce erosion and sediment yield to Little Cherry Creek.

Noranda would design a permanent diversion channel to transport runoff from the tailings impoundment surface to Bear Creek. The channel would reduce erosion along the hillslope and consequent transport of excess sediment into Bear Creek.

Noranda would conduct chemical analyses (acid-base accounting) on the barren zone material. If these materials exhibit acid generating potential, these materials would be separated from other waste rock for special handling. A detailed handling plan would be developed and submitted to the agencies. No acid generating materials would be used in the construction of the tailings impoundment dam.

Noranda would conduct chemical analyses of the overburden material immediately overlying the proposed mine workings during operations to determine sulfide mineral content, acid generation potential, and metal concentrations. The results of this sampling would be included in Noranda's monitoring program and would be considered in Noranda's evaluation of post-operations discharge from the mine (see Ground Water Hydrology section).

Since acid generation occurs primarily in an oxidizing environment above the ground water table, possible adverse effects on water quality could be reduced by placing acid generating waste rock below the level to which ground water is expected to occur following operations. In the absence of plugging, mine water is expected to rise to the elevation of the lowest adit (the Libby Creek adit). If acid-generating materials are identified, Noranda could be required to place all potential acid-generating waste rock below anticipated post mining water levels in the mine as part of the handling plan.

Other impacts described under Alternative 1 would occur.

ALTERNATIVE 3

Noranda would collect and treat all excess mine, adit and tailings water prior to surface discharge in Libby Creek. A seepage collection system (gravel drains) would be constructed beneath the tailings impoundment, and most seepage would be collected prior to entering ground water. The amount of seepage that would not enter the seepage collection system and would, therefore, enter underlying ground water would be dependent on the final design of the gravel drains. For the purposes of the analysis, the agencies assumed 300 gpm (out of 475 gpm) would be collected and treated, 85 gpm would be collected by Noranda's proposed pressure relief system and 90 gpm would enter the ground water system and ultimately Libby Creek. Noranda would submit final design of the gravel drain system to the agencies for approval. Mine and adit water would be gravity-fed down to the treatment system near the tailings impoundment.

Following discharge of mine and adit water and treatment (Years 2 and 3 of construction), expected water quality in Libby Creek (station LB 2000) under low flow conditions and average flow conditions is shown in Tables 4-16 and 4-17, respectively. Expected water quality following treatment of most tailings water under low flow and average flow conditions is shown in Tables 4-18 and 4-19, respectively. Using a wetland system, increases in total dissolved solids, ammonia, and nitrates/nitrites concentrations over ambient stream concentrations would increase during low and average flow conditions under both discharge scenarios.

With the two mechanical treatments, slight increases in nitrates/nitrites and ammonia also would occur under both discharge scenarios. Total dissolved solids would also increase following treatment of most tailings water in Year 16 of operations. The projected increases would be small and may not be detectable by monitoring. Manganese concentrations would exceed existing concentrations during low flow periods following wetlands and electrocoagulator treatment during Years 2 and 3 of construction. During low flow conditions, copper and manganese concentrations would also exceed ambient conditions for all treatment alternatives in Year 16 of operations (Table 4-18). All projected increases in constituent concentrations for all treatment systems would be below applicable stream standards. Treatment of mine and adit discharge would only be necessary during a 2-year period prior to mill operation. Under all treatment systems, BHES would have to grant a waiver allowing for a change in ambient stream water quality. A discharge permit would also be required.

Expected concentrations of copper and manganese during low flow conditions for two discharge scenarios (Years 2 and 3 of construction and Year 16 of operations) following water treatment are shown in Figure 4-3. Expected concentrations under Noranda's proposed system are also shown. Some of the differences between concentrations expected under Noranda's system for Years 2 and 3 of construction and concentrations expected following treatment is attributed to discharge location. The treatment alternatives would discharge near station LB 2000; Noranda's proposed percolation ponds would discharge near station LB 800, upstream of station LB 2000. Flow volumes are greater at station LB 2000 than at station LB 800, consequently providing greater dilution of discharges.

Table 4-16. Expected surface water quality changes in Libby Creek (station LB 2000) during low flow conditions following discharge of adit and mine water (Years 2 and 3 of construction) and water treatment.

Parameters	Surface water standard	Analytical detection limit§	Existing water quality†	Projected water quality: Wetlands	Projected water quality: Evaporator	Projected water quality: Electrocoagulator
	(mg/L)					
Total dissolved solids	500	1	41	70	35	35
Ammonia	2.2	0.05	<0.05	<0.41	<1.81	<0.13
Nitrate/nitrite	10	0.01	0.03	0.76	0.74	0.16
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	<0.0010	<0.0008	<0.0008	<0.0008
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.001	<0.001	<0.001
Iron	0.3	0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.04	<0.03	<0.02
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0003	<0.0003	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-17. Expected surface water quality changes in Libby Creek (station LB 2000) during average flow conditions following discharge of adit and mine water (Years 2 and 3 of construction) and water treatment.

Parameters	Surface water standard	Analytical detection limit§	Existing water quality†	Projected water quality: Wetlands	Projected water quality: Evaporator	Projected water quality: Electrocoagulator
	(mg/L)					
Total dissolved solids	500	1	20	23	20	20
Ammonia	2.2	0.05	0.08	<0.11	<0.09	<0.23
Nitrate/nitrite	10	0.01	0.06	0.12	0.07	0.12
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	0.0004	<0.0004	<0.0004	<0.0004
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	0.002	<0.002	<0.002	<0.002
Iron	0.3	0.05	0.05	<0.05	<0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.02	<0.02	<0.02
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0003	<0.0003	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-18. Expected surface water quality changes at station LB 2000 during low flow conditions following discharge of tailings water and water treatment (Year 16 of operations).

Parameters	Surface water standard	Analytical detection limit§	Existing water quality†	Projected water quality: Wetlands	Projected water quality: Evaporator	Projected water quality: Electrocoagulator
	(mg/L)					
Total dissolved solids	500	1	41	56	42	42
Ammonia	2.2	0.05	<0.05	<0.29	<0.21	<0.67
Nitrate/nitrite	10	0.01	0.03	0.52	0.33	0.51
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	<0.0010	<0.0009	<0.0009	<0.0009
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.002	<0.002	<0.002
Iron	0.3	0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.04	<0.03	<0.04
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0004	<0.0004	<0.0004
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

Table 4-19. Expected surface water quality changes at station LB 2000 during average flow conditions following discharge of tailings water and water treatment (Year 16 of operations).

Parameters	Surface water standard	Analytical detection limit§	Existing water quality†	Projected water quality: Wetlands	Projected water quality: Evaporator	Projected water quality: Electrocoagulator
	(mg/L)					
Total dissolved solids	500	1	41	21	21	21
Ammonia	2.2	0.05	<0.05	<0.10	<0.10	<0.10
Nitrate/nitrite	10	0.01	0.03	0.09	0.09	0.09
Aluminum	No standard	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	0.00002	0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	0.0003	0.0001	<0.0010	<0.0004	<0.0004	<0.0004
Chromium	0.011	0.02	<0.02	<0.02	<0.02	<0.02
Copper	0.003	0.001	<0.001	<0.002	<0.002	<0.002
Iron	0.3	0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.0004	0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.05	0.02	<0.02	<0.02	<0.02	<0.02
Mercury	0.000012	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	No standard	0.05	<0.05	<0.05	<0.05	<0.05
Silver	0.00012	0.0002	0.0003	<0.0003	<0.0003	<0.0003
Zinc	0.027	0.02	<0.02	<0.02	<0.02	<0.02

Source: Existing water quality—Chen-Northern, Inc. 1989. Appendix G.
§Estimated mine, adit and tailings water had higher detection limits for some parameters.
†Existing water quality values assumes detection limit value for metal concentrations at or below the detection limit.

The water from the treatment systems would be discharged to Libby Creek near station LB 2000. Because the area of physical disturbance would be smaller, less erosion would occur and less sediment made available for transport to adjacent streams. Runoff and sediment control would still be required during wetland construction.

Noranda would use the percolation pond site for disposal of ice and snow removed from the surface facilities. This practice would prevent sediment (possibly containing toxic metals) trapped in the ice and snow from reaching adjacent streams. Since the percolation ponds are not constructed, an alternative ice and snow disposal plan may be required.

ALTERNATIVE 4

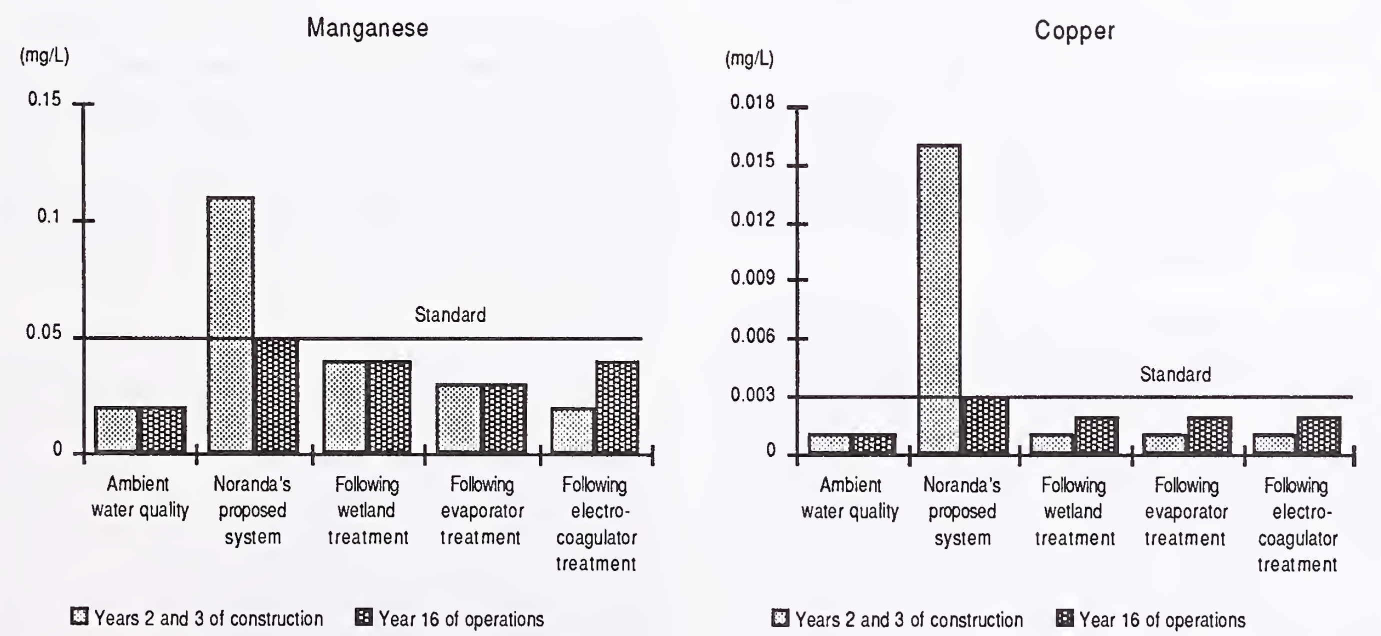
A helicopter would be used for line stringing, avoiding impacts that would be caused by bulldozer stringing equipment. Using a helicopter would prevent sedimentation impacts at the bulldozer crossings of the Fisher River, Howard Creek, and Libby Creek, where existing bridges would provide access for other construction activities. Crossings for pole placement activities would still be required on Ramsey Creek. The crossing location and method would be determined by the agencies following a field investigation. As with Alternative 1, two or three structures would be located in the flood plain of the Fisher River.

ALTERNATIVE 5

The hydrology impacts of the North Miller Creek transmission line route would be the same as Alternative 4, for several locations where the line would cross the Fisher River, where construction would be within 200 feet of Miller Creek, and where construction across Ramsey Creek is required.

In the upper Miller Creek drainage, this route would be situated close to an unnamed intermittent stream for about 1.5 miles. Due to the steepness of this drainage, any access roads and line construction disturbances would be located away from the stream

Figure 4-3. Expected copper and manganese concentrations during low flow conditions for two discharge scenarios following water treatment



channel to avoid long-term erosion and sedimentation.

Both Howard and Libby creeks are crossed by this alternative, but existing bridges would provide access to the line and no new stream crossings would be required. This alternative also crosses Ramsey Creek. A temporary stream crossing would be needed and would introduce small amounts of sediment into the stream.

ALTERNATIVE 6

As with the other alternatives, about 1,400 feet of new road construction would be located on very steep slopes within 200 feet of the Fisher River. Some sediment would probably reach the river when these roads are constructed. The Fisher River shows signs of channel movement in the vicinity of the proposed crossing north of the river's confluence with Brulee Creek. Increasing the structure height and span length or other design alternatives would help ensure that future channel movements do not pose a hazard to structures near the river.

Without these modifications, it is estimated that six structures would be located in the 100-year flood plain of the Fisher River. The river shows evidence of meanders in the area and has been rerouted to prevent damage to one nearby residence.

Two perennial streams, Schrieber Creek and Brulee Creek, are crossed by Alternative 6 in the vicinity of the Fisher River crossing. Construction access to structures is available without any additional stream crossings on each creek.

This route would have the same effects on Howard and Libby creeks as Alternative 5. Existing bridges would be used to provide access to the line, and no new stream crossings would be required on Howard and Libby creeks. As with Alternatives 1, 4, and 5, a stream crossing probably would be needed on Ramsey Creek.

ALTERNATIVE 7

Under this alternative, the projected increase in sedimentation, streamflow and water quality changes in project area streams as a result of the proposed Montanore Project would not occur.

CUMULATIVE IMPACTS

Cumulative impacts for all alternatives would be similar. ASARCO's proposed Rock Creek project in the Rock Creek watershed would not affect the quantity or quality of water in Libby Creek. No cumulative effects are anticipated on Libby Creek from the two mine operations.

The timber sales currently projected in the Libby Creek or Fisher River watersheds may potentially increase peak flows. Increased flows would temporarily reduce the effects of the Montanore Project. The KNF requires the implementation of Best Management Practices during logging operations. If these practices are properly implemented and maintained, then additional sediment transport into the Libby Creek drainage would be minimal.

RESOURCE COMMITMENTS

Under Alternative 1, proposed discharges and tailings pond seepage would alter the water quality in Libby and Ramsey creeks, primarily by increasing the concentrations of total dissolved solids, metals and nutrients. Changes would be greatest during seasonal low flow periods. Increases would be less with water treatment systems proposed in Alternative 3.

Surface water quality effects would decrease following mining operations as impoundment seepage decreases. Some seepage from the impoundment would continue as long as the impoundment exists. The tailings are not anticipated to be acid generating, and the quality of the discharge would remain the same or improve with time. The abandoned mine workings would eventually fill with water and might discharge to the surface. The

quality of this post-mining mine water discharge cannot be accurately predicted at this time. Noranda would plug the adit unless the expected discharge would meet water quality standards (see following section).

GROUND WATER HYDROLOGY

SUMMARY

As proposed in Alternative 1, seepage from the tailings impoundment would enter the shallow underlying aquifer or emerge as springs and seeps around the boundary of the impoundment. Some seepage would be intercepted by the pressure relief system, and the remainder would discharge to Libby Creek.

During operations, Noranda would continuously evaluate mine inflows. If substantial inflow should occur, possible connection to surface water bodies would be evaluated. Noranda proposes to maintain a minimum distance of 500 feet from Rock Lake and 100 feet from the Rock Lake fault.

Following operations, water levels in the mine would rise until surface discharge occurs along natural pathways or at the mine adits. This water is expected to be relatively good quality; however, the potential for the generation of acid mine drainage exists. If acid mine drainage does occur, or if inflows to the underground workings indicate a surface connection, portal plugs would be constructed inside the mine adits.

Under Alternatives 2 and 3, mining within 200 feet of the Rock Lake Fault and 750 feet of Rock Lake would be restricted. Noranda would be permitted to mine closer to these areas if agency review of underground studies indicates that narrower avoidance areas would be acceptable. These measures would reduce the chances of affecting surface water resources in the Cabinet Mountain Wilderness and intercepting the Rock Lake Fault. A more comprehensive monitoring program would be implemented.

Under Alternative 3, Noranda would construct a gravel drain system beneath the tailings impoundment for interception of seepage which would enter the ground water under Alternative 1. Seepage into ground water would be significantly reduced. Ground water in the percolation pond areas would not be affected. The transmission line alternatives (4, 5, and 6) would not affect ground water. Ground water quantity and quality would remain in the present condition under Alternative 7.

ALTERNATIVE 1

Mine Area

Ground water in the mine area occurs primarily in fractures (joints and faults) in metasedimentary bedrock. As the mine adits, and eventually the mine workings, are extended below the water table, ground water would flow into the underground workings (mine inflows). Mine inflows would be greatest when a saturated fracture—or fracture system—is first encountered by the mine adit or workings. Within a short time, inflow from the fracture would decline as ground water stored in the fracture flows into the mine workings. Inflow would still continue from the fracture, but at the rate

of ground water recharge to the fracture or steady state conditions.

The number and size of the fractures encountered is expected to decrease with the depth of the mine, but considerable inflow to Ramsey Creek and Libby Creek adits is anticipated. Noranda has estimated steady state condition inflow during mining. An estimated 392 gallons per minute would flow into the adits. An additional 560 gpm would flow into the mine workings.

It is not possible to predict the short-term, maximum inflow rates as individual fractures and fracture zones are encountered. The proposed operation has been designed to handle temporary mine inflows of 2,000 gpm. Noranda anticipates that mine water inflow would be used as makeup water in the process circuit. However, if sustained excess (>1,200 gpm) mine inflow occurs, Noranda has identified a number of measures which could be undertaken. These include fracture grouting, segregation of clean inflow waters, and temporary storage in the tailings impoundment (see Chapter 2, Water Use and Management.) Other alternatives would also be considered.

Mine inflows potentially would be greatest when mining encounters major faults or fault zones, such as the Snowshoe Fault or the Rock Lake Fault. Major faults might act as conduits for vertical ground water flow and provide a hydraulic connection between mine workings and overlying surface or ground water. Overlying surface and ground water resources could be adversely affected, if faults act as ground water conduits and if Noranda's grouting program is ineffective.

Underground collapse and decompressional fracturing might result in increased inflows into the mine. As discussed in the subsidence section (Geology and Geotechnical), underground collapse might extend three to five times (and possibly as much as ten times) the original mine height. If the collapse zone and associated decompressional fracturing intersect natural fractures and faults not previously dewatered by the mine workings, increased mine inflows would result. Underground collapse would also reduce the long term effectiveness of Noranda's proposed fracture grouting program to control mine water inflow.

Prior to mill operation, mine water would be pumped to the surface and discharged to ground water near the Libby Creek adit and in lower Ramsey Creek by use of percolation ponds, infiltration trenches, or land application. The excess water disposal system would have the capacity to store or discharge up to 2,000 gpm of excess water. Seepage from the disposal system would enter shallow ground water systems discharging to Libby Creek. To minimize potential effects to ground and surface water quality, Noranda may segregate inflows and remove the water from the underground workings before it comes into contact with mining activities where its quality would be impaired.

After the mill becomes operational, mine water would be used as makeup water in the process circuit. If mine inflows remain low, as projected, disposal of excess mine water would not be required. The excess water disposal system, however, would remain in place as a backup in the event that disposal of excess water becomes necessary. Noranda anticipates that use of the excess water disposal system after the tailings impoundment is operational would be infrequent and of short duration.

Following operations, mine water would no longer be pumped from the underground workings, and the mine workings would fill with water until the rate of inflow equals the rate of outflow. It is not known how long it would take the mine to fill with water. Outflow would occur along natural pathways (fractures), or if water levels rise sufficiently, from the mine adits. Since the Libby Creek adit is located at a lower elevation, mine water discharge would be likely to occur there. Outflow from the adit would be sufficient to prevent further flooding of the mine workings.

The quality of the post operations mine water cannot be accurately projected at this time. Noranda

anticipates it would probably have a similar or better quality than mine water pumped from the workings during operations (Table 4-10). Post-mining water quality may exceed ambient water quality in receiving streams. In addition, the discharge might be acidic and contain higher concentrations of dissolved metals than currently expected. Acid generation primarily occurs as a result of sulfide mineral oxidation and bacterial action above the water table. Acid generating potential would be somewhat reduced in those portions of the mine workings which would flood following operations. If discharge would occur from the Libby Creek adit, about 3,000 feet of workings would remain above the water level. Water quality would depend on the acid-generating potential of the barren (lead) zone, ore remaining in pillars, and surrounding waste rock within this portion of the mine.

In response to this uncertainty, Noranda would monitor inflow to underground workings during operations to be able to predict whether the adits would discharge mine water following operations, and whether the expected flow would meet applicable water quality standards. If it is determined that there would be problems with the discharge, the adits would be plugged following the cessation of operations.

Adit plugging is a technique used to control and redirect mine water flow. It does not, however, prevent mine water discharge and is not a water treatment technique. When water quality may be affected, plugging is combined with a water treatment technology.

If the adits are successfully plugged, the mine water would rise until the outflow along natural pathways equals the rate of mine water inflow. Ground water elevations may return to their pre-mining levels. Instead of one or two point-source discharges at the mine adits, mine water discharge would be more diffuse, occurring as springs and seeps, discharge to valley fill ground water systems, and/or baseflow in streams. (If the adit plugs are not successfully implemented, leakage would occur around the plugs, and the rise in mine water levels would be less.) It is not known what effect adit plugging would have on the quality of the discharge. Adit plugs have an expected life of several tens to hundreds of years. Without periodic inspection and maintenance, the adit plugs may eventually fail.

Tailings Impoundment Area

The tailings impoundment is designed to seep to promote geotechnical stability. Seepage would occur both through the bottom of the impoundment and through the embankment. Seepage moving through the embankment would be collected by a blanket drain and directed to a collection pond located downstream of the impoundment. Seepage would be impounded in an unlined collection pond formed by a collection dam. The pond would extend to a maximum depth of about 50 feet below the existing drainage bottom. Collected seepage would also be pumped back to the tailings impoundment during the mine life.

Only the impounded tailings immediately adjacent to the tailings embankment would contribute seepage to the embankment and ultimately to the seepage collection pond. Following operations and removal of the seepage collection dam, the seepage through the embankment would enter Little Cherry Creek as surface flows.

Seepage from the bottom of the tailings impoundment may enter the shallow ground water system in the glaciofluvial aquifer, or emerge as springs and seeps near the tailings impoundment. The seepage rate would increase over the 16-year impoundment life, from approximately 50 gpm during Year 1 to an estimated 475 gpm in Year 16 (Noranda Minerals Corp., 1989e, p. 23*ff*). Tailings water emerging from springs and seeps around the boundary of the impoundment would be collected and pumped back into the impoundment. A portion of the seepage entering the glaciofluvial aquifer would be intercepted

by the pressure relief/seepage interception system and pumped back to the impoundment.

Water from the impoundment entering the glaciofluvial aquifer would discharge to Little Cherry Creek and Libby Creek through the ground water systems. At an estimated ground water flow rate of 0.1 to 4 feet per day (Noranda Minerals Corp., 1989h), it may take up to several decades for seepage to reach Libby Creek.

The quality of the tailings water is not expected to change significantly before discharging to Libby Creek (Table 4-10). Although some reduction in metals concentrations may occur along the flow path, dilution and dispersion are not expected to significantly alter the quality of the tailings water discharge (Noranda Minerals Corp., 1989a.).

Following the cessation of mining, tailings would no longer be slurried to the tailings impoundment. Water recharging the tailings impoundment would consist only of infiltration from natural precipitation and runoff from adjacent areas, and water levels within the impoundment would drop until steady state conditions are achieved. Following reclamation, seepage would decrease and could reach less than 100 gpm at steady state conditions.

The lowering of water levels in the tailings impoundment would expose any sulfide mineralization in the tailings to oxidation and bacterial action. This could result in the generation of acid mine drainage and the release of dissolved metals to ground water (and indirectly to surface water). Initial testing of the tailings material, however, indicates the tailings would not be acid forming (Table 4-6). Therefore, long-term degradation of the tailings water quality would not be expected to occur. Following operations, Noranda would monitor water quality in the vicinity of the tailings impoundment. If problems are identified, appropriate remediation would be implemented. Measures could include water treatment or capping of the impoundment.

Monitoring Program

Noranda has proposed an operational water resource monitoring program (Appendix B). Noranda is currently conducting an interim monitoring program (Chapter 2). The proposed monitoring programs would include surface water, and ground water sampling programs.

Operational monitoring would begin during the first quarter of operation of the mill and the tailings impoundment facility. The interim monitoring program has been implemented. Nine surface water monitoring stations would be established on Ramsey Creek, Libby Creek, and Little Cherry Creek. Libby Creek baseline monitoring station LB 800 would not be included in the operational monitoring program. Surface water samples would be collected seasonally, during spring low flow, spring high flow, late summer low flow, and fall low flow. No samples would be collected during the six-month period between fall low flow and spring low flow.

Ground water samples would be collected from 17 monitoring wells near the plant site and percolation pond areas, the Libby Creek adit area, and the tailings impoundment area. Monitoring wells in the Ramsey Creek area would be sampled quarterly, while monitoring wells in the Libby Creek and Little Cherry Creek areas would be sampled seasonally.

Surface and ground water samples would be analyzed for field parameters (pH, specific conductance, and temperature), total dissolved solids, major and minor ions, nutrients, and trace metals. Surface water samples would be analyzed for total recoverable metals. Ground water samples would be analyzed for dissolved metals. The monitoring plan does not indicate if stream flow and water level measurements would be made when water samples are collected. The proposed monitoring plan includes both field and laboratory QA/QC programs to ensure the quality of the samples collected.

An annual report would be prepared to summarize information and data collected during the year. It is

not clear if the annual report would include copies of laboratory reports (raw data) and the results of field and laboratory quality control programs. (This information is necessary for the regulatory agencies to determine if the monitoring results are useable.) Any actual or potential impact identified during routine monitoring would be reported immediately to the regulatory agencies.

ALTERNATIVE 2

Noranda would be restricted from mining within 200 feet of the Rock Lake Fault and 750 feet of Rock Lake. This would decrease the potential for intercepting significant quantities of water from the fault zone and affecting the lake water levels. Noranda would be permitted to mine closer to these areas if agency review of underground studies indicates that narrower avoidance areas would be acceptable.

Noranda would plug the mine adits if the water that would discharge from the adits following mining would not meet state and federal water quality standards. Successful plugging would eliminate the discharge from the adits but discharge would eventually occur along natural pathways. If plugging is not successful, leakage around the plug would occur. There are several known documented cases of plugging failure (T. Erickson, U.S. Bureau of Mines and G. Farmer, USDA, May 3, 1990 pers. comm. with C. Pagel, DSL). It is not known what effect plugging would have on the quality of the water discharged at other locations. It is premature to select a remedy before the nature of the problem has been identified. A series of internal adit plugs may be appropriate if the intent is to control outflow or to restore (to the extent possible) pre-mining ground water levels in the mine area. If water quality standards cannot be met, water treatment might be required. It may be necessary to combine technologies to control mine outflow and to test water quality. Noranda would be required to consider other remedies and to select the most appropriate remedy for the agencies' approval after monitoring has identified what the problem, if any, would be.

The proposed operational monitoring program would incorporate hydrologic monitoring activities identified in the permit application into a comprehensive monitoring program completely described in Appendix B. The purpose of increased monitoring is to evaluate the extent and magnitude of impacts and to allow changes in operating procedures if necessary. Results of all monitoring would be provided in an annual report. Specifically, the following revisions to the monitoring programs would be included—

- Continuous monitoring and evaluation of mine inflows, and if substantial inflow were to occur, the evaluation of possible connection to surface water bodies, including using analytical techniques to determine the age of the water;
- Monitoring of inflow to the underground workings during operations to predict whether discharge would occur at the mine adits following operations, and to predict the expected quality of the discharge (currently proposed by Noranda);
- Monitoring of water levels in Rock, Libby, and St. Paul Lakes (currently proposed by Noranda);
- Continuous monitoring of surface water discharge from Rock Lake;
- Continuous monitoring of surface water flows at LB 2000;
- Monitoring wells near the percolation pond areas seasonally instead of periodically;
- Micro-seismic monitoring of fracturing in overlying rocks in the mined area to determine the extent of destress fracturing and to verify the Rock Lake Fault and crown barrier pillar thickness required to prevent interception of ground water;
- Inclusion of Libby Creek monitoring station LB 800 to the surface water operational monitoring program;
- Inclusion of a mid-winter surface and ground water sampling event to the operational monitoring program;
- Inclusion of all laboratory reports (raw data) and the results of QA/QC programs in the annual report submitted to regulatory agencies;

- Maintenance of a detailed project water balance as revised by the agencies (see Appendix B); and
- Geotechnical testing described in Appendix B.

Other ground water impacts would be the same as Alternative 1.

ALTERNATIVE 3

The agencies would require construction of a seepage collection system (gravel drains) beneath the tailings impoundment. This system would intercept the water discharging to ground water under Alternative 1, and would discharge the water to a seepage collection pond. Water would then be pumped to a treatment system. Changes in ground water quality would be reduced. The agencies have estimated that 300 gpm (out of 475 gpm) of tailings impoundment seepage would be collected by system. About 85 gpm would be intercepted by Noranda's proposed pressure relief system and the remaining 90 gpm would enter the shallow ground water system underlying the tailings impoundment. The ground water in the percolation pond area would not be affected. Other impacts to ground water under this alternative would be the same as Alternatives 1 and 2.

ALTERNATIVES 4, 5 AND 6

Ground water resources would not be affected by the proposed transmission line.

ALTERNATIVE 7

If the proposed Montanore Project permit is denied, the ground water impacts would not occur. Dewatering of the bedrock ground water system in the mine area would be less. Mine water discharge also would be less. Ground water quality at the Little Cherry Creek tailings impoundment site would not be degraded by tailings water seepage. Existing ground water characteristics, including recharge, flow paths, discharge, and water quality would remain as they are currently.

CUMULATIVE IMPACTS

No cumulative impacts to ground water in the project area would occur for any alternative. The impacts of the proposed project would be limited to the vicinity of the mine area, and to the Little Cherry Creek tailings impoundment site. No ground water effects would result from the proposed timber sales. ASARCO's proposed Rock Creek project which includes underground mining and a proposed tailings impoundment would have hydrologic effects similar to those identified for Noranda's proposed operations, but would affect bedrock ground water systems on the western side of the Cabinet Mountains in the lower Rock Creek/Clark Fork river alluvial ground water system.

RESOURCE COMMITMENTS

Water currently stored in joints and fractures would be drained and used in the milling process or discharged to percolation ponds, and ultimately to ground water. Overlying surface and ground water resources could be adversely affected if faults act as ground water conduits or if Noranda's grouting program is ineffective. Following mining, water would continue to flow into the mine workings unless joints and fractures are grouted or the adit is plugged. Water levels in the mine would rise until surface discharge occurs along natural pathways or at the mine adits.

Some existing springs and seeps would be covered by the tailings impoundment, but these might reemerge downgradient of the tailings embankments. Seepage through the tailing impoundment bottom would enter the shallow underlying aquifer and could also emerge as new springs and seeps around the boundary of the impoundment.

Surface or ground water would be used for make-up and potable water. Prior to withdrawal of surface water, Noranda would obtain necessary water rights and permits.

FISH AND OTHER AQUATIC LIFE

SUMMARY

Project area streams are typically low in bedload sediment. This is partly the result of high stream flow from spring rains. The proposed project would result in slight increases in sediment loads and turbidity downstream of the proposed project. Under all alternatives, impacts to fish and other aquatic life from increased sedimentation would be insignificant—to some extent, increased sedimentation might actually benefit aquatic life.

Increased concentrations of minerals and nutrients would increase the productivity of many aquatic populations. Not much is known about the effects of increased metals concentrations on organisms inhabiting very soft waters, such as in the Libby Creek drainage. Baseline metals concentrations indicate some potential risk to aquatic populations, but the extent of risk is not known. Noranda's proposed discharge would increase metals concentrations in Libby and Ramsey creeks.

Under Alternatives 2 and 3, an expanded monitoring program would be implemented to evaluate impacts, so that steps could be taken, if necessary, to protect resident aquatic populations. Appropriate measures would also be implemented particularly at stream crossings during road construction to ensure adequate fish passage.

Changes in transmission line construction methods in Alternatives 4, 5, and 6 would slightly reduce the amount of sediment reaching the Fisher River and Ramsey Creek. Existing conditions would be maintained with Alternative 7.

ALTERNATIVE 1

Potential impacts to fish and other aquatic life in the Libby Creek drainage from the proposed Montanore Project can be grouped under five general concerns: sediment, water quantity, water quality, toxic metals, and fish passage.

Sediment

While minimal increases in bedload sediment and turbidity loads would occur downstream due to the proposed project, two environmental characteristics of the Libby Creek drainage system limit the potential for adversely affecting fish and other aquatic life. First, these streams frequently have violent seasonal high flows that accompany early-winter or springtime rain-on-snow events. These intense flows restrict accumulations of smaller gravel and finer sediment in these streams. As a result, much of the sediment entering the upper Libby Creek drainage from the proposed project area would be carried downstream by these flows.

Second, gravels (1/4- to 2-inch diameter) and smaller-sized particles (less than 1/4 inch diameter) provide important habitat for fish spawning and for propagation of aquatic insects (Everest et al, 1987). These materials are in short supply in Libby Creek and in downstream reaches of most tributaries draining the proposed project area. Increasing the availability of both materials in area streams could benefit resident fish and aquatic invertebrates in three ways—

- Additional smaller gravel would increase the availability of sites having suitable spawning habitat. This might increase reproductive success by fish populations (Reiser and Bjornn, 1979).
- Additional finer sediment would contribute to increasing invertebrate productivities and enhancing the food supplies for fish. This also would increase fish productivities (Reiser et al, 1987).
- Additions of both smaller gravel and finer sediment could eventually help to stabilize the streambed substrate (Reiser et al, 1985). This would reduce the potential severity of periodic intensive flows and downstream loss of fish and fish-food organisms during the intense flows.

Operational monitoring would be required to evaluate accurately the actual effects of any alteration of in-stream sediments. Proposed monitoring is discussed in Appendix B.

Constructing the transmission line and associated roads across or along streams would also add sediment to project area streams, including Fisher River and Libby Creek drainage. Sediment would originate from structure sites, access roads, and bulldozer crossings (for sock line pulling). The sediment increases would be neither large enough nor of sufficient duration to noticeably affect fish populations. The potential for large amounts of sediment to enter the Fisher River by way of Sedlak Creek during substation construction is expected to be low. Erosion control systems at the plant site would minimize sedimentation problems from the Ramsey Creek substation.

Water Quantity

Streamflow volumes would increase as waters from the percolation ponds and tailings impoundment seep into ground water and ultimately discharge into Libby Creek. During periods of average to high flows, the increases would not significantly affect fisheries or the aquatic environment. During periods of low flows, such increases would augment low streamflows and increase the availability of habitat suitable for aquatic life. This would affect aquatic populations by increasing their productivity and reproductive potentials at these times.

Water Quality

The surface waters of the Libby Creek drainage have low concentrations for most dissolved constituents (metals and nutrients). As discussed in Chapter 3, concentrations of most metals are near or below analytical detection limits in these streams. The extremely low nutrient concentrations severely limit productivity and produce marginal habitat conditions for fish and other aquatic life.

Accompanying the potential increased volume of water entering streams in the Libby Creek drainage, hydrologic analyses show that the Montanore Project could increase in-stream concentrations of all dissolved constituents considered, except for zinc (Table 4-10). The increases in nutrients (e.g. nitrates), and most minerals (calcium, potassium, etc.) would increase productivity of the aquatic community and growth rates for fish. Any actual productivity increase would be slight because the magnitude of these increases in dissolved concentrations is slight. Low nutrient and mineral concentrations would continue to limit productivity.

The potential for impact on the aquatic community accompanying any increases in heavy metals concentrations is unclear. Allowable increases in lake- or stream-specific limits in cadmium, copper, chromium, lead, silver, and zinc are calculated (EPA, 1986). The EPA equations may not accurately account for the effects of low water hardness levels on metals toxicity to fish. Therefore, the EPA equations may not reliably predict potential toxic impacts for increased metals concentrations in soft waters such as those in the Libby Creek drainage.

Water hardness measured in samples from Libby Creek and its tributary streams was lower than 3 mg/L in some areas. Montana surface water quality standards (aquatic life standards) use 20 milligrams (mg) calcium carbonate per liter ($CaCO_3$/L) hardness to calculate specific limits for metals in soft waters

($\leq$ 20 mg $CaCO_3$/L). Since the water hardness in these streams is generally less than 5 mg/L and the validity of the EPA equations at water hardnesses of 5 mg/L or less is uncertain, the concentrations of these metals that would actually cause toxicity in these waters are unknown. There is little basis for assessing the potential for additive toxicity among these metals in very soft waters. Without additional research, there can be no reliable estimate of the metal concentrations causing toxicity or of the effect of additional sediment loading on aquatic life.

The low concentrations of dissolved materials in surface waters of the Libby Creek drainage also cause these waters to tend toward acidic pH levels, and to tend to have extreme sensitivities to fluctuations in acidity. For most heavy metals, the percentage of the metal occurring in the dissolved form increases with increasing acidity. It is in this form that many metals have greatest potential toxicities and impacts to fish and other aquatic organisms. Without a better approach, the EPA equations suggest that metal toxicity presents high potential risks to aquatic life now inhabiting these streams. While the presence of diverse size classes of fish in area streams suggests that toxicity is not currently controlling these populations, it is not known whether chronic metal toxicity might be contributing to the low population densities in these streams. The projected increases in dissolved concentrations of heavy metals accompanying the Montanore Project would increase the potential for risk and future impact to these fish.

Toxic Metals in Fish

Baseline study results show low concentrations of zinc, cobalt, copper, lead, and mercury occur in the fish of Libby Creek. Since zinc, cobalt, and copper are essential human nutrients and human consumption of fish from these streams is low, human health risks are probably low. As noted in the previous section, it is unknown whether fish are currently being affected by metal toxicity in these streams.

The concentrations of mercury and lead found in fish from these waters does signify a need for continuing concern. Both elements can pose significant health risks to humans. Based on FDA standards, mercury concentrations in fish flesh for human consumption may not exceed one microgram per gram (µg/g). There is presently no standard for lead. Mercury concentrations found in the sampled fish average approximately 20 percent of the FDA regulation, indicating there is no present risk. If mining increases concentrations of either metal in surface waters, they might also increase in fish tissues suggesting an increased risk for potential impacts to fish and other aquatic life, and an increased risk to human consumers of these fish.

Fish Passage

Reconstructing and constructing approximately 18 miles of KNF roads between U.S. 2 and the proposed plant site would include several stream crossings including those on Bear, Little Cherry and Poorman creeks. If appropriate stream crossing standards are not followed, construction of these crossings might block fish passage on these three creeks.

The mine plan also calls for construction of a permanent diversion of Little Cherry Creek around the planned tailings impoundment. This diversion is planned to be double the natural stream width, resulting in a significant decrease in stream depth. The reduction in stream depth and construction of rockfill bars to slow water velocities would effectively eliminate fish migration and residency through the diverted reach during periods of low flow. During these periods, resident fish would be forced out of this stream, or forced to seek refuge in any pools remaining above the diverted reach. With extreme low flows, the planned diversion would eliminate the habitat for rainbow trout in upper Little Cherry Creek.

Threatened, Endangered or Sensitive Species

No adverse impacts to any threatened, endangered or sensitive aquatic species is expected.

Monitoring

Noranda has proposed an aquatic macroinvertebrate monitoring program (Appendix B). The plan would not, however, evaluate metals concentrations in resident fish.

ALTERNATIVE 2

Noranda would construct access roads in accordance with the Soil and Water Conservation Handbook (Kootenai National Forest, 1987, Appendix 25). Implementation of construction techniques described in the handbook would ensure fish passage and decrease fish mortality and sediment production.

Noranda would implement the modifications to the aquatics monitoring program as described in Appendix B. The goal of the revised monitoring plan would be to evaluate potential impacts and to quantify actual impacts to fish and other aquatic life resulting from construction, operation, and reclamation of the Noranda Montanore Project.

ALTERNATIVE 3

Noranda would treat excess water prior to discharge using a wetland, electrocoagulator, or evaporator treatment system. The system would reduce the amount of metals entering Libby and Ramsey creeks. Risk to resident fish might be reduced. Projected increases in nutrient concentrations resulting from discharge of the treated water would likely have a beneficial effect to aquatic life. Projected increases in manganese concentrations would likely have no effect to aquatic life.

ALTERNATIVES 4 AND 5

Using a helicopter instead of a bulldozer to pull the sock line for transmission line construction would reduce contributions of sediment to the Fisher River and to Ramsey Creek. Crossing Libby and Howard creeks only on existing bridges would nearly eliminate sediment increases in these streams. Effects of sediment on fish populations of the four streams would be less than the effects of Alternative 1.

ALTERNATIVE 6

The impacts of Alternative 6 on the Libby Creek drainage would resemble those described for the other transmission line alternatives. Impacts to the Fisher River drainage would be less than the impacts of Alternative 1 and slightly greater than impacts of Alternatives 4 and 5. Reducing sediment by eliminating bulldozer crossings would be offset by increased sediment at the Schreiber Creek crossing (see Surface Water Hydrology). Alternatives 1, 4 and 5 would not affect this creek.

ALTERNATIVE 7

Under this alternative, productivity of fish and other aquatic life in Libby Creek drainage would continue to be limited by low nutrient concentrations and by habitat changes caused by high flows and naturally occurring concentrations of heavy metals.

CUMULATIVE IMPACTS

If timber operations in the Libby Creek drainage follow KNF's Best Management Practices, increased sediment and nutrients would be limited. There would be no cumulative impacts to fish or aquatic life from the proposed ASARCO Rock Creek Project.

RESOURCE COMMITMENTS

A slight increase in suspended sediments and nutrients could increase biological productivity. The effects of increased metals on aquatic life is not known. A population of small trout could be destroyed upstream of the Little Cherry Creek diversion.

WILDLIFE

SUMMARY

Alternative 1 would disturb a total of 1,206 acres of wildlife habitat. An additional 19 acres have been disturbed with the construction of the Libby Creek adit. Wildlife use of the disturbed areas, particularly big game species, would be disrupted and may be displaced during the life of the operation. Reclamation of disturbed areas after mining would result in the reforestation of disturbed areas and the eventual restoration of useful habitat.

Indirect impacts to wildlife during operations would result from increased human activities. The extent and location of these impacts is difficult to predict. Mountain goats, moose, grizzly bear, and black bear would be the species most likely affected. Noranda would implement a grizzly bear mitigation plan consisting of habitat replacement and grizzly bear mortality reduction primarily through implementation of road closures on National Forest System lands.

Instead of road closures, Noranda would acquire suitable grizzly habitat as a mitigating measure under Alternative 2. Replaced habitat would occur sooner than proposed by Noranda. Other modifications under Alternative 2 would reduce indirect wildlife impacts. Mitigation proposed under Alternative 3 would reduce the amount of disturbed grizzly bear habitat. If wetland treatment is implemented, the habitat suitable for waterfowl would slightly increase.

Alternatives 5 and 6 would result in less displacement of elk from areas affected by the transmission line in comparison to Noranda's proposal. Alternative 6 would have the least effect on big game, particularly elk. Wildlife impacts described in the six action alternatives would not occur under Alternative 7.

ALTERNATIVE 1

Surface disturbances associated with the proposed project would affect 1,225 acres of wildlife habitat (Table 4-20 and Table 4-21). Of this total, 20 acres clearing for the proposed transmission line and associated access routes would not be required (Table 4-21). Wildlife of these areas, particularly big game species, would be disrupted during the life of the operation. Wildlife species would be displaced to other areas. Songbird and small mammal species which depend exclusively on the habitat types disturbed by mining would experience population reductions within the wildlife project area in proportion to habitat lost.

Clearcut habitat would comprise half of total disturbed area. Timbered habitat would make up the majority of the remaining affected area, with Riparian, Grassland and Shrubfield insignificantly affected.

Noranda would remove existing vegetation prior to construction of the proposed percolation ponds. This area might convert to a different habitat type than those currently present. Although the nature of this habitat cannot be determined, the percolation pond areas would be available to some species.

Important Wildlife Species

Mountain goats. Mountain goats would not be directly affected by habitat disturbance. Constructing

Table 4-20. **Wildlife habitat acreage disturbed by mine facilities and road construction.**

Habitat	Plant site	Tailings impoundment	Percolation ponds	Libby Creek adit to Ramsey Creek Road	Ramsey Creek plant site to U.S. 2	Total
Clearcut	0	382.4	26.8	13.4	16.3	438.9
Grassland	0	0	0	1.9	0	1.9
Lodgepole	0	24.2	0	0	0	24.2
Mixed conifer	0	300.5	4.3	7.6	44.6	357.0
Riparian	0	0	0	1.9	0	1.9
Shrub field	24.6	0	9.8	0	19.5	53.9
Spruce-fir	20.3	0	0	9.6	10.8	40.7
Western hemlock	0	21.6	37.1	0	30.2	88.9
Total	44.9	728.7	78.0	34.4	121.4	1,007.4†

Source: IMS Inc. 1990.
†19 acres has been disturbed at the Libby Creek adit site.

the transmission line along Ramsey Creek would probably not affect wintering mountain goats. However, cumulative noise and human activity associated with plant construction in Ramsey Creek might move goats inhabiting Ramsey Creek to other portions of their home range for the duration of construction activities. Goats would likely return to Ramsey Creek following construction.

Poaching of mountain goats might increase throughout the Cabinet Mountains as the population of Lincoln County increases. Since mountain goats

Table 4-21. **Acres of wildlife habitats and soil disturbance by transmission line project.**

Alternative	Total disturbance†	Coniferous forest to be cleared§‡	Soil disturbance in existing clearcuts
1	199	179 (71)	20
4	197	187 (41)	10
5	176	165 (34)	11
6	182	166 (32)	16

Source: Department of Natural Resources and Conservation. 1990.
†Total disturbance is the sum of coniferous forest to be cleared and soil disturbance in existing clearcuts. Totals include and assume the following: 1 acre disturbed for the substation at Sedlak Park; and 0.25 acres disturbed for microwave repeater on Barren Peak.

§Acreages in parenthesis represent soil disturbance for transmission line construction activities that would occur within areas of new clearing. These figures are included in the numbers shown for coniferous forest to be cleared to avoid double counting where both new clearing and soil disturbance are expected in the same area.

‡All routes would affect areas designated for old growth management in the forest plan. Only Alternative 6 would affect areas mapped during baseline studies as having old growth characteristics for wildlife habitat. A total of about 5 acres of old growth would be cleared by Alternative 6.

have a relatively low reproductive rate, any increase in mortality could have significant adverse effects on mountain goat populations.

Elk, moose, deer and black bear. The Miller Creek transmission line route passes through more elk security range than the other alternatives (Table 4-22). More roads would be required due to fewer existing roads. The bulldozer trail created to pull the sock line would function as a road.

The berms proposed at the road entrance would not be effective barriers to motorized vehicles. Small all-terrain vehicles and motorbikes could be driven over the berms and, depending on adjacent terrain, larger 4-wheel drive vehicles could be driven around the berms. Gates could be used with or in place of the berms, but they also could be circumvented or pulled down. Even with the most effective barriers, the roads would encourage persons on horses or afoot to enter the elk security areas (McCollough et al. 1987; Canfield, 1988).

Elk hunters may use the access roads to hunt the Miller Creek headwaters. Elk that leave the headwaters to avoid hunters may encounter cleared areas, or areas more accessible by road, where they would be more likely to encounter hunters. Constructing the powerline during the hunting season would create even greater displacement effects.

Habitat disturbance within the elk security area would have little impact on elk. Twenty-three acres would be disturbed within the 39 acres which would require tree clearing (Table 4-22). Tree clearing may increase forage for elk; however, the benefits would be small since forage supplies are usually adequate on summer-fall ranges and the addition of 39 acres to those areas would not produce large amounts of forage.

Elk share the winter range along Miller Creek with deer and moose (Figure 3-8). Similar to impacts in

Table 4-22. Big game range affected by transmission line construction.

Alternative	Distance crossed by right-of-way	New access roads[1]	Area requiring tree clearing[2]	Ground disturbed within cleared areas[3]
	miles		acres	
Elk security range[4]				
1	1.8	3.0	39	23
4	1.8	2.4	39	19
5	1.2	1.6	28	23
6	0.3	0.0	0	<1
Winter range[5]				
1	3.8	2.8	34	10
4	3.8	0.9	34	6
5	3.5	1.1	30	7
6	0.0	0.0	0	0

Source: Department of Natural Resources and Conservation. 1990.
[1]Includes bulldozer trail for sock line pulling.
[2]Reduced by acreage already in clearcuts (no clearing required).
[3]Structures, roads, bulldozer trails, and construction sites.
[4]Range used by elk during summer and fall as identified by DFWP and USFS.
[5]Range for moose, deer, and elk as identified by DFWP.

the elk security area, human activities in winter range would have more adverse effects than would habitat loss (Table 4-22). Line construction, including blasting, with a 23-person crew could occur during winter. This activity would displace big game animals from range near the transmission line. Displacement distance for big game species cannot be predicted precisely; published studies suggest it may range from 1/8 to 1/2 miles (Ward, 1976; Ward, 1985; Knight, 1980; Ferguson and Keith, 1982; Perry and Overly, 1977; Rost and Bailey, 1979). If this displacement were to occur, a major portion of the Miller Creek winter range would be lost. Because winter range often determines big game population levels (Mautz, 1978), populations segments relying on the Miller Creek range might decline.

Tree clearing would increase forage in the Miller Creek winter range; however, this benefit would not be great enough to offset the negative effects of displacement (Table 4-22). Impacts of improved vehicle access into winter range would be limited by snow blocking the roads. Snowmobiles may still be able to travel through the winter range. Deer and other big game animals would avoid roads during periods of snowmobile use (Dorrance et al., 1975).

Keeping the Bear Creek Road open throughout the year would result in more recreational use of this area during the winter. Much of the area is moose winter range. Human interactions with moose would increase during winter, and would likely result in stress to moose during a period when other stress factors are also high. The result might be some moose mortality due to starvation or disease, but more likely increased access would result in increased poaching and road kills.

Habitat within 0.25 mile of the mine facilities and access road would probably receive less use by big game due to human activity at the facilities and along the road during the construction phase. There would continue to be a zone of influence of up to 0.25 mile at the plant site and along the access road during operation, but this zone of influence probably should not affect big game use at the tailings pond and the percolation ponds. The exact extent of this zone of influence would vary depending on the species and habitat type involved. Black bear and elk are the least tolerant of human activity while deer are the most tolerant. The zone of influence would be less in habitats which provide good hiding cover such as timbered areas and old clearcuts. The 500 percent increase in traffic on the access roads would result in a proportional increase in traffic accidents involving big game.

Although much more difficult to predict and quantify, indirect impacts to big game would likely be greater than direct impacts. Big game species range throughout the project area and might be affected by both increased hunting and recreational road use. These impacts would be due to increased recreational activity resulting from the anticipated population increase, expected to be about two percent, in Lincoln County. Increased motorized recreational activity might reduce habitat use near roads in the Cabinet Mountains. Increased non-motorized activities might decrease habitat utilization.

An additional effect of increased hunting is that it causes black bears to be more wary of human activity. Black bear use of habitat may decrease near roads and trails where hunting occurs.

Improper garbage containment at mine facilities might act as a bear attractant. This has two potential effects. One is the obvious effect on human safety. The other is that bears may habituate to human activity and become problem bears. The presence of problem bears at the mine would necessitate efforts to relocate problem bears. Repeated relocation failures or unusual circumstances may result in the death of individual problem bears.

Other wildlife. Other wildlife species would be directly affected by habitat disturbance. They would also be susceptible to some of the indirect impacts resulting from increased human population and activity. Small game species would be susceptible to

both legal hunting and poaching. Most small mammals would be susceptible to road kills.

Waterfowl might occasionally collide with transmission line ground wires at crossings of the Fisher River and Howard and Libby creeks. Annual mortality would be insignificant due to low flight intensities.

Habitat disturbed by the transmission line and associated roads would have only negligible effects on raptors, songbirds, and small mammals in the transmission line corridor (Table 3-16 and Table 4-21). A few potential and actual nest sites in snags or cottonwoods, would be lost to tree clearing. A small number of trees used by perching raptors also might be removed. Species of songbirds and small mammals inhabiting cleared areas would differ from those that inhabited the undisturbed forests.

Grizzly Bears

Three ecosystems have been designated by the U.S. Fish and Wildlife Service for a concentrated grizzly bear recovery effort (U. S. Fish and Wildlife Service, 1982). The Cabinet-Yaak ecosystem (CYE) is located in northwestern Montana and northern Idaho. The Cabinet portion of the ecosystem is located south and west of U.S. 2 and the Yaak portion is located north of the highway. The Montanore Project is located in the Cabinet portion of the CYE.

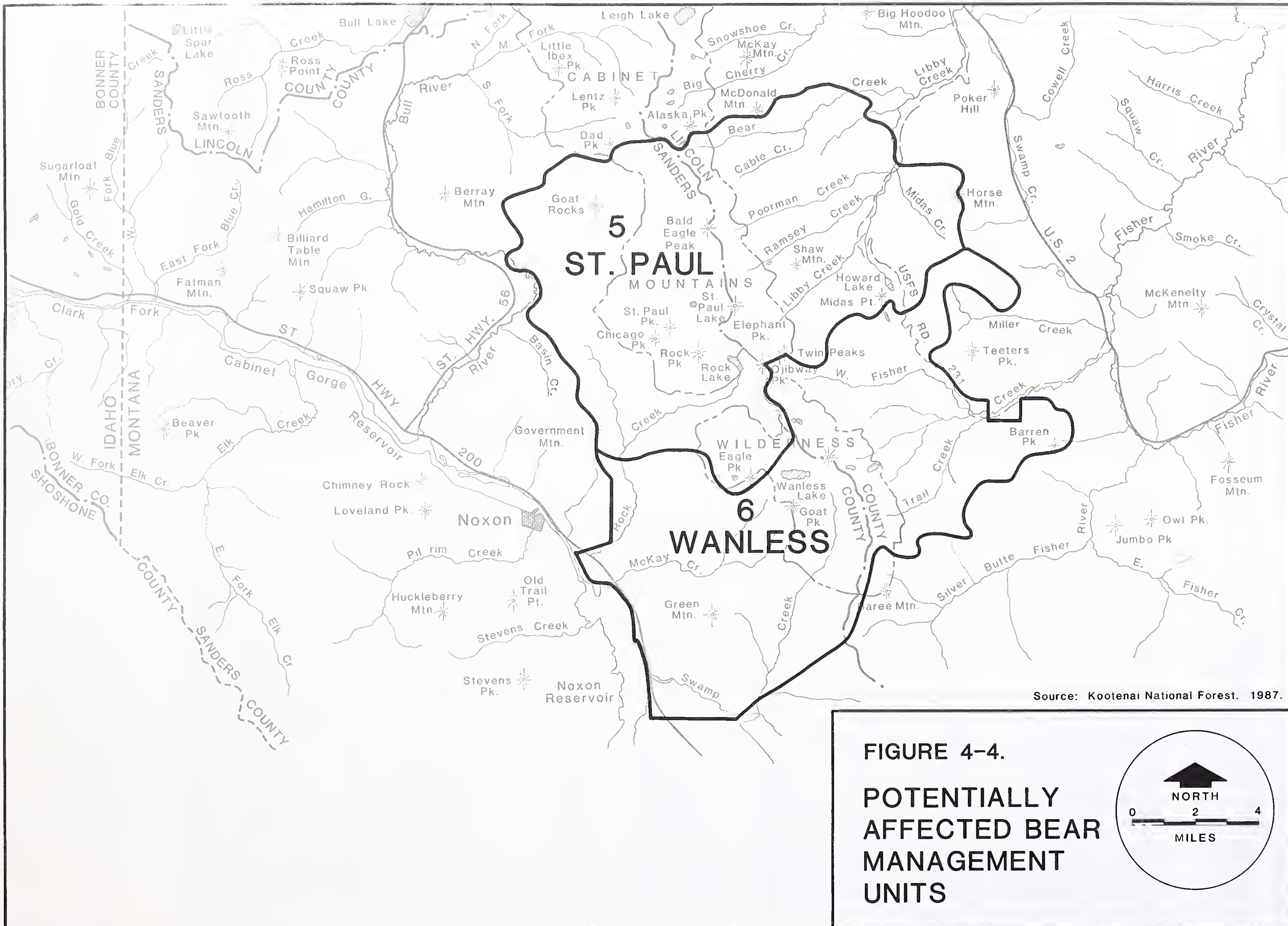
One of the primary tools used for this assessment was a computer model, details of which are described in the *Cumulative Effects Analysis Process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems* (U.S. Forest Service, 1988). The model analyses the effects of various activities on bear management units (BMUs) which have been established within the CYE to assist in addressing cumulative effects on the grizzly bear and its habitat. Each BMU theoretically represents a viable home range of an adult female grizzly (approximately 100 square miles). The Montanore Project would affect habitat within BMUs 5 and 6 (Figure 4-4).

The model estimates grizzly bear habitat effectiveness and provides a mortality risk index, a measure of mortality risk. Habitat units reflecting the quality of a given land area can also be generated. The model serves as a tool to assess the effects of proposed activities, and to monitor changes in habitat effectiveness as a result of those activities. The model is not good at predicting indirect impacts.

Habitat effectiveness is a hypothetical index of the seasonal ability of a specific habitat to support bears in relation to their ability to use that habitat in the presence of human activity. Values for habitat effectiveness are derived from two submodels—the habitat submodel and the displacement submodel. The habitat submodel qualitatively estimates the value of a given area to the grizzly bear, incorporating food and edge for an early (den emergence to July 31) and late (August 1 to denning) season. The displacement submodel quantifies the effects of disturbance associated with human activities on the grizzly bear's ability to use a specific habitat. Habitat effectiveness is the resulting interaction of the two submodels. Increased human activity results in higher levels of bear displacement. Reduction in human activity or an increase in habitat value resulting from vegetation changes or enhanced food values yield higher habitat effectiveness values.

The mortality risk index provides comparative values quantifying the change in the risk of mortality to bears. The computer model is sensitive to hunting and non-hunting periods to reflect the probability of bear mortality by firearms during a human/bear encounter.

Habitat units represent the value of an area for grizzly bear use. Habitat units do not reflect the influence of various activities on an area. The basic analysis unit in the CEM is the mapped habitat component or vegetation polygon, which describes a discrete vegetative or topo-edaphic unit. Each habitat component type is given seasonal coefficients on the basis of seasonal grizzly bear food potentials. For example, a



Source: Kootenai National Forest. 1987.

FIGURE 4-4.

POTENTIALLY AFFECTED BEAR MANAGEMENT UNITS

100-acre polygon with a spring coefficient of .60 would represent 60 spring habitat units.

Project construction would have both direct and indirect effects on the grizzly bear. Direct effects are those on-site activities which would alter habitat, displace bears from habitat they normally use, or affect the productivity, survival, or mortality of the grizzly. Indirect effects are those caused by a proposed action, but occur later in time or outside the project area. Increased off-site (beyond the permit area) recreation which are not directly related to the operation of the mine, but are related to the increased population resulting from the mine would be an indirect effect. Indirect effects can also affect grizzly bear productivity, survival, and mortality.

Direct impacts. The Montanore Project would physically disturb 1,225 acres, including 19 acres of private land from the current construction of the Libby Creek adit. Physically disturbed areas having above average food values for the grizzly bear—logged areas, shrubfields, meadows, and riparian areas—would total about 620 acres. Within the mine area, about 8,780 acres are currently influenced by existing activities, primarily roads. The Montanore Project would influence or physically disturb 5,148 acres. About 4,716 acres currently not influenced by any activities would be affected during the construction phase and 3,933 acres currently not influenced by any activities would be affected during the operation phase.

The east side of the Cabinet Mountains provides important spring habitat, which is very limited in BMU 5 (Madel, 1983). All drainages on the east side of the Cabinet Mountains are very important year-round habitat and very important in the overall recovery scheme. Much of the affected habitat would occur in the Ramsey Creek drainage. The upper Ramsey Creek drainage currently has very little activity. The entire drainage would be influenced by project activities. In terms of habitat quality, about 1,174 habitat units would be lost as result of the construction and operation of the Montanore Project (Table 4-23). These 1,174 habitat units consist of the habitat units affected directly to mine facilities and to habitat displacement in areas which currently have little or no activities occurring in them (primarily in the upper Ramsey Creek drainage). Noranda's proposed mitigation plan is designed to replace these lost habitat units.

Bears currently occupying the project area or bears from a future larger population would be displaced because of increased human activity in the project area. Bears would tend to avoid areas of activity, and consequently would lose available habitat. Bears would avoid the project area more during the construction phase than during the operations phase. Construction activities would generally be more intense (louder and longer) and more widespread than during operational activities.

During operations, bear use would be expected to decrease in an area 0.25 miles on either side of the access roads and transmission line corridor. Construction of the percolation ponds and tailings impoundment areas would disturb some habitat, but

Table 4-23. Grizzly bear habitat units affected by Montanore Project activities.†

	Plant site	Ramsey Creek drainage§	Tailings impoundment	Libby Creek adit	Percolation ponds	Roads	Transmission line	Total
Habitat units	495.5	354	114	17.5	60.5	100	32.5	1,174

Source: IMS Inc., 1990, in cooperation with the KNF.
†Detailed calculations available in project file at KNF Supervisor's office.
§Area which currently has little disturbance.

there would be no zone of influence around either project component during operation. Under the present situation, some displacement already occurs in the proposed project area, particularly near the percolation pond and tailings impoundment, because of human use on existing roads.

Without mitigation, the Montanore Project would also affect grizzly bear habitat effectiveness (Table 4-24). Maximum habitat effectiveness (HE) is 1.0. Habitat effectiveness of BMU 5 with no activities present would be 0.373 during season 2. Activities currently occurring in BMU 5 have caused a 26 percent reduction of season 2 HE to 0.274. Operation of Montanore Project without mitigation would reduce BMU 5 season 2 HE a further 10 percent to 0.248. Habitat effectiveness also would be reduced slightly in BMU 6. After mine closure, bears would forage on revegetated lands, and habitat effectiveness would increase.

It does not appear that any denning habitat would be affected by the Montanore Project. Except for the adits, most of the facilities would lie in or near drainage bottoms where there is no evidence of denning.

A possibility of increased mortality to grizzly bears exists as a result of project-related activities. Grizzly mortalities could result from bears being hit by vehicles traveling to the mine or by the shooting of bears by employees. Bears that might be attracted to the project area by garbage refuse or purposeful feeding could become nuisances or damage complaint animals. Such bears can be relocated, but a nuisance bear is usually eventually killed.

The Montanore Project would create an increased mortality risk during the spring and fall seasons (Table 4-25). Mortality risk with no human activities present is 0 and increases with increased activity. Activities currently occurring in BMU 5 increase season 2 mortality risk to about 0.353. During operations, the Montanore Project without mitigation would increase mortality risk 26 percent (to 0.446) over the present situation. Mortality risk indices are useful in comparing alternatives, but without further model calibration, it is difficult to show how many bears might be killed. In other words, it is not known what a 30 percent increase in mortality risk means in absolute terms, other than there is a higher likelihood of bear mortality than if there were no increase. Likewise, a decrease in the mortality risk only indicates that grizzlies may be less susceptible to human caused mortality.

At present, a reduction in habitat effectiveness of 26 percent has almost brought the Cabinet grizzly bear

Table 4-24. Predicted grizzly bear habitat effectiveness for the baseline conditions, the present situation and following implementation of the Montanore Project without mitigation.

	Bear Management Unit 5		Bear Management Unit 6	
	Season 1†	Season 2	Season 1	Season 2
Baseline conditions‡	0.351	0.373	Not available	
Present situation	0.248	0.274	0.222	0.229
Montanore Project				
Construction phase	0.218	0.244	0.220	0.228
Operation phase	0.224	0.248	0.221	0.229

Source: IMS Inc., 1990, in cooperation with the KNF.
†Two seasons are evaluated: Season 1—early season, 4/1 to 7/30, and Season 2—late season, 8/1 to 11/30.
‡Habitat effectiveness with none of the present activities in the BMU.

Table 4-25. Predicted grizzly bear mortality risk for the present situation and following implementation of the Montanore Project without mitigation.

	Bear Management Unit 5		Bear Management Unit 6	
	Season 1[†]	Season 2	Season 1	Season 2
Present situation	0.246	0.353	0.408	0.584
Montanore Project				
Construction phase	0.308	0.485	0.409	0.587
Operation phase	0.284	0.446	0.408	0.584

Source: IMS Inc., 1990, in cooperation with the KNF.
[†]Two seasons are evaluated: Season 1—early season, 4/1 to 7/30, and Season 2—late season, 8/1 to 11/30.

population to extinction, based on research data compiled by the Montana Department of Fish, Wildlife, and Parks from 1983 to 1987 (Kasworm and Manley, 1988). Considering that the proposed project would increase mortality risk 26 percent above the present situation, and decrease habitat effectiveness another 10 percent (over one-third the current impact), the threat to recovery appears significant and adequate mitigation is essential. Despite the fact that the model has not been calibrated, it must be assumed that any increase in mortality risk or decrease in habitat effectiveness could result in serious consequences for the grizzly bear given the current precarious state of the population.

Indirect impacts. Indirect or off-site effects are those effects that occur away from the project site or later in time and are due primarily to increases in human population. Human population increase would lead to increased recreational use of bear habitat. This raises the potential for grizzly displacement, and increased human/grizzly conflicts which can result in grizzly mortality.

Current grizzly bear mortality in the Cabinet-Yaak Ecosystem is not accurately known, but is thought to be high (Knick and Kasworm, 1989). Trails and roads that provide access to primary attractions such as lake basins or scenic viewpoints receive a large percentage of the total use in the Cabinet Mountains Wilderness and surrounding roaded areas (KNF Libby Range District recreational use files, 1990). These routes would likely receive increased use proportionate to the anticipated population increase. With more people entering grizzly habitat during spring, summer and fall months, certain areas would probably become less secure habitat. As more people/bear interactions occur over time, the potential for human-induced mortality also rises through removal or illegal kills (Martinka, 1982).

Patenting of mill claims by Noranda could lead to development of these lands in a manner detrimental to the grizzly bear after mine closure and reclamation. Although it is not known what lands, if any, Noranda might patent, they have the right to patent any of their claims which they occupy. Lands that could be patented include the mill site, percolation ponds and tailings impoundment.

Previous cumulative effects analysis procedures (Christensen and Madel, 1982) used a threshold of 70 percent freely available space (undisturbed habitat) within each bear unit. Forest-wide standards and guidelines for grizzly bear management, described in the Forest Plan, (Kootenai National Forest, 1987) require that 70 percent freely available space be present within each BMU before additional activity can be permitted. The 70 percent freely available area must also be contiguous within the BMU with no major barriers preventing a bear's

movement in or through the entire freely available area. If this condition is not present at any given time, the KNF is required to take immediate action to bring the space requirement up to at least the 70 percent minimum threshold before permitting any activities. The two BMUs affected by the Montanore Project are presently above the 70 percent threshold. The Montanore Project would not reduce any of the units below this threshold (Table 4-26).

Noranda's proposed mitigation plan. Noranda's proposed mitigation plan would replace the 1,174 grizzly bear habitat units affected by the project through road closures, habitat acquisition, habitat enhancement and protection, and mortality reduction. Noranda is currently investigating several mechanisms to guarantee that funding for the mitigation plan is available. The plan would also establish a management committee to oversee the administration and implementation of the various mitigation measures. The committee would be composed of supervisory personnel from the U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Department of Fish, Wildlife, and Parks, and Noranda.

Noranda's mitigation plan would mitigate indirect impacts by increasing wildlife law enforcement and establishing a public education program. Noranda would provide funding for a full-time local enforcement officer through the Montana Department of Fish, Wildlife, and Parks for the life of the project. Noranda would also provide funding for a local education and information person through the first five years of the project. After five years, equivalent funding would be available for this position or other activities approved by a management committee. This program has been recommended by the agencies and would likely reduce grizzly bear mortality associated with increased recreational activities.

Table 4-26. Freely available (uninfluenced) habitat in BMUs 5 and 6.

Area	BMU 5 (sq. mi.)	BMU 5 (%)	BMU 6 (sq. mi.)	BMU 6 (%)
Total	103	—	109	—
Area currently available	81.5	79.1	78	71.6
Area available with Montanore Project operating	75.8	73.6	77.4	71.0

Source: IMS Inc., 1990 in cooperation with the KNF.

Noranda has further addressed the mortality issue by suggesting evaluation of selective restrictions of the hunting seasons in areas of high grizzly bear use. Although Noranda's plan does not specify what these restrictions would be, two frequently mentioned include closing the fall black bear season on November 1 and removing the black tag from the sportsman's license. These restrictions were recommended by Kasworm and Manley (1988).

Black bears in the Cabinet Mountains tend to be in their dens by the end of October, while grizzly bears tend to den in late November or early December (Kasworm and Manley, 1988). Closing the black bear season on November 1 would likely reduce accidental shooting of grizzly bears by black bear hunters.

Most recently, documented grizzly bear mortality associated with hunting in the Cabinet Mountains has been by elk hunters. Removing the black bear tag from the sportsman's license and requiring a separate bear license would license people who would actually be hunting bears and who may be more adept at bear identification.

The KNF does not have the authority to restrict hunting seasons. Early closure of the black bear season would have to be done by the Montana Fish, Wildlife, and Parks Commission, while removing the black bear tag from the sportsman's license would require action of the Montana legislature.

Road closures are a very effective way of compensating for lost grizzly bear habitat. Closures provide an increase in available habitat units since bears would tend to use more of the habitat near the

road. Road closures also reduce the potential for human/bear interactions and the resulting potential for bear mortality.

The KNF has estimated that average habitat units per acre in BMU 5 is 0.34 habitat units/acre. If the value of habitat along closed roads were equal to this average, 109 habitat units would be gained per mile closed. If the value of habitat along a closed road was low, for example, 0.1 habitat units/acre, 32 habitat units would be gained per mile. The lower Granite Road, which Noranda proposes to close seasonally, is 4.5 miles long. Closure of this road would increase available habitat between 144 to 490 habitat units. Noranda may investigate other potential road closures in consultation with the KNF. The potential exists for Noranda to gain most or all of the lost habitat units through road closures.

Noranda would acquire sufficient land to replace habitat units not replaced by road closures. Under Noranda's proposal, all land acquisitions would be subject to the approval of a management committee. Lands would be acquired by purchase of private lands or by acquisition of conservation easements over an 11-year period from the start of construction. Noranda would manage all lands acquired and provide an annual report to the management committee. At the end of the project and reclamation period, Noranda would retain the right to offer purchased lands for sale to a private trust or to the U.S. Forest Service. Noranda would also transfer title of their land within the tailings impoundment area and at the Libby Creek adit (subject to previous owner's right of first refusal) to the U.S. Forest Service at the end of operations.

With the approval of the management committee, Noranda would replace some lost habitat units by enhancing habitat on acquired lands. As proposed by Noranda, habitat enhancement would increase the number of habitat units available to the grizzly bear.

Habitat enhancement methods may include physical manipulation of habitat such as burning, logging, and revegetation to increase habitat quality. Habitat enhancement could also include changes in management such as closing roads to acquired parcels, reduced livestock grazing, and siting of hunting camps away from heavily used fall habitat.

Noranda has proposed that the KNF implement year-round closure of three National Forest System roads (10.9 miles) and seasonal closure of four National Forest System roads (20.1 miles). The KNF has two of these roads (5.8 miles) under consideration for permanent closure. These closures may provide necessary replacement habitat.

Other Threatened or Endangered Species and Sensitive Species

Since gray wolf and woodland caribou are not reported to occur in the area, they are unlikely to be affected by mining activities. Canada lynx and wolverine are uncommon in the wildlife project area, and are unlikely to be significantly affected by mining activities.

Peregrine falcon and bald eagle are unlikely to be significantly affected by mining activities because they rarely enter the proposed mine area. Coeur d'Alene salamanders occur in the Bear Creek and Libby Creek and might be adversely affected by road construction adjacent to these creeks.

Constructing the transmission line would add minor amounts of sediments to tailed frog habitat in the Libby Creek drainage (see Surface Water Hydrology). The levels and duration of sediment increases, however, probably would not be enough to harm tailed frogs.

ALTERNATIVE 2

Impacts to the grizzly bear due to Alternative 2 are the same as for Alternative 1. Alternative 2 differs in the means of mitigating impacts to grizzly bears, primarily in the mitigation of direct impacts.

Indirect impacts. The Alternative 2 would mitigate indirect impacts to grizzly bears by having Noranda fund two positions, a law enforcement position and

an information and education position over the life of the project. Alternative 2 would not include modification of hunting seasons.

Containers used for trash and garbage at all project facilities would be of a type that would not allow foraging by bears. This would reduce interaction between humans and grizzly bears.

Noranda would remove all road killed animals from roads and road rights-of-way within the permit area and along all access roads on a daily basis. Road kills would be moved at least 100 feet beyond the right-of-way clearing and be out of sight from the road. This measure would minimize the chance of undesirable bear encounters.

Direct impacts. Alternative 2 would mitigate the loss of 1,174 grizzly bear habitat units by land acquisition over a three or four-year period from project initiation. This land acquisition would be funded by Noranda. The land would provide suitable grizzly bear habitat and would be located in or adjacent to currently occupied grizzly bear habitat. All of the land acquired would be purchased by the agencies and controlled and managed by the KNF.

Alternative 2 would also have Noranda provide in fee title to the USFS all mill site claims patented by Noranda in relation to the Montanore Project.

Funding mechanism. Alternative 2 recommends a trust fund agreement. Under this agreement, Noranda would establish a trust fund with sufficient funding for the two full-time positions and for acquisition of the necessary lands. The trust would be administered by supervisory personnel of the USFS, the U.S. Fish and Wildlife Service and the MDFWP. These agencies would make all decisions regarding expenditures of trust moneies.

Other wildlife. Noranda would implement a number of measures, such as maintaining a speed limit not to exceed 45 mph on the access road, and developing an education program for workers, designed to reduce indirect wildlife impacts. Employing bussing would reduce road kills along the access road.

The Big Hoodoo Mtn. Road (#6747) would be closed to all motorized traffic during the winter season (December 1 to April 30) to provide security for wintering moose. This measure would reduce the impact from the expected displacement of moose in the tailings impoundment area. Other impacts described under Alternative 1 would occur.

ALTERNATIVE 3

Construction of a wetland would provide a small amount of habitat for waterfowl and shorebirds. The 78 acres presently providing grizzly bear habitat would not be disturbed by the construction of the percolation ponds. Indirect impacts would also be reduced since there would be no construction or operation activities at the percolation pond sites. Other impacts described under Alternative 1 and 2 would occur.

ALTERNATIVE 4

A road management agreement for transmission line access roads would be developed by Noranda and the agencies to protect wildlife against impacts from increased access.

Alternative 4 would increase elk hunting pressure in the Miller Creek headwaters. Displacement of elk from secure habitat to less secure habitat by hunters would be somewhat lower than Alternative 1. The decrease in displacement would result from a 0.6 mile reduction in access roads due to the absence of bulldozer trails (Table 4-22). Under Alternative 4, the KNF would require Noranda to eliminate tie-through access between existing roads and those proposed in the upper Miller Creek drainage for transmission line construction. This measure would minimize elk displacement outside of hunting season. Changes in elk habitat would be nearly identical to changes caused by Alternative 1.

ALTERNATIVE 5

This alternative would require fewer access roads in elk security range than do Alternatives 1 and 4 (Table

4-22), decreasing impacts to elk. Since a helicopter would string the sock line and connecting roads would be restricted, impacts would resemble those of Alternative 4. All other impacts would be essentially identical to those described for Alternative 4.

ALTERNATIVE 6

Alternative 6 combined with required mitigations nearly eliminates impacts to big game animals. No winter range would be crossed and only 0.3 miles of elk security range would be crossed.

Clearing for the line would remove about five acres of habitat known to be important to pileated woodpeckers, barred owls, and pygmy owls. Impacts to all other wildlife species would be insignificant.

ALTERNATIVE 7

Disturbance of wildlife habitat and wildlife displacement described under the six action alternatives would not occur.

CUMULATIVE IMPACTS

Cumulative impacts are similar for all alternatives. ASARCO's Rock Creek Project combined with the Montanore Project would result in an estimated 2.7 percent population increase in Lincoln and Sanders counties. This population increase would result in a proportional increase of indirect impacts described for Alternative 1. Other mining activities would contribute to indirect impacts proportional to the size of the mining activity.

Proposed timber sales during the next ten years would convert 1,650 acres of timber currently used for big game cover to areas which would provide better big game foraging opportunities, at least until canopy closure. Road construction and use and logging activities would reduce big game habitat up to 0.25 miles from these activities during daylight hours. These reductions in habitat use would remain relatively constant as old timber sales are completed and new sales begin. Increased forage availability in completed sale areas may partially offset some loss of use due to new sales.

RESOURCE COMMITMENTS

Habitat disturbance and displacement would increase animal numbers in areas not affected by the project, increasing competition for food. Some species, such as mule deer or elk, may eventually return to disturbed areas or use nearby habitat during project operation. After mine closure, wildlife would slowly return to the mine areas, as vegetation cover and production returns to pre-mine levels. The grizzly bear would incur an increased risk of mortality and temporary displacement.

SOILS, VEGETATION AND RECLAMATION

SUMMARY

Under Alternative 1, the Montanore Project would result in the disturbance of 1,225 acres. Impacts to soils and vegetation would be limited to areas used for surface facilities and transportation and transmission line corridors. As part of Noranda's reclamation plan, soil would be stripped from most areas to be disturbed. Most salvaged soil would be stockpiled in revegetated stockpiles. During final reclamation, stockpiled soil would be redistributed on

disturbed areas and revegetated. Prolonged stockpiling of soils would have some adverse impacts. With successful revegetation, long-term impacts to vegetation and soils resources would be negligible.

Under Alternatives 2 and 3, the Bear Creek Road would be returned to its pre-mine width and the disturbance associated with the road reclaimed. Alternative 3 would result in no surface disturbance at the proposed percolation pond area and decreased soil erosion. Alternatives 4, 5, and 6 would have significantly less road construction than Alternative 1. Less soil erosion would occur under the three transmission line alternatives. Surface disturbances would not occur under Alternative 7.

ALTERNATIVE 1

Vegetation Production and Diversity

Successful implementation of the reclamation plan would result in the re-establishment of a viable, self-perpetuating forest ecosystem on most disturbed lands. Revegetation would not result in the restoration of native vegetation habitats. In time, however, reclaimed areas would become in most ways indistinguishable from surrounding undisturbed areas. Factors affecting this would include invasion of reclaimed areas by species from undisturbed areas and the rate of vegetation community succession. Fire, disease and management would also affect the post-mining vegetation.

Although reclamation of tailings impoundment would result in reforestation, future harvesting of timber would not be allowed in order to protect the long-term integrity of the impoundment. If timber harvesting were restricted on all disturbed areas associated with the impoundment, 729 acres of potential commercial timber stands would be lost. Upon reclamation, however, this land would be productive as wildlife habitat (see Land Use section).

Revegetation may not be successful on all disturbed areas. Revegetation may fail where—

- topsoil is absent, as on cut slopes;
- soils are deeply compacted;
- slopes above access roads fail;
- traffic on access roads after revegetation crushes seeded plants and compacts soils; or
- soils erode before vegetation becomes established.

The first four situations could cause localized revegetation failures anywhere along the transmission line or mine access roads. Soils along the transmission line corridor are most likely to erode near the Fisher River, the headwaters and lower stretch of Miller Creek, and the area between Howard Lake and Libby Creek. Prior to vegetation reestablishment, the embankment face probably would erode. Simple reseeding might establish vegetation on some failed areas, while other areas might need slope or soil stabilization before reseeding. Steep slopes with inadequate topsoil may never adequately support vegetation.

Unique and Valuable Vegetation Types

A number of wetland areas were identified in the project area. In the vicinity of the mine, most of these areas, including the largest wetland encountered in the mine area near the Ramsey Creek plant site, would not be disturbed by the proposed developments. Impacts to these wetland areas would accordingly be negligible.

Two small wetland areas, comprising about three acres, occur in the location of the proposed tailings impoundment. Disturbance of these areas would fall under the regulatory purview of Section 404 of the Clean Water Act administered by the U.S. Army Corps of Engineers. The Corps of Engineers may

require relocation or re-establishment of wetland habitat as a conditional requirement in approving the plan to construct the tailings impoundment at the proposed location. Enforcement of such a requirement would result in no net loss of wetland habitat.

Construction of project facilities would destroy old growth habitat. About 25 acres of old growth timber specifically designated in the KNF Forest Plan (1987) would be destroyed by the tailings impoundment. Other areas of old growth timber not specifically designated in the Forest Plan also would be affected by the project. Prior to permitting the cutting of any old growth timber, the KNF would ensure compliance with KNF standards that at least 10 percent old growth timber remains in each major drainage.

Although not officially listed as a sensitive species by the KNF, the northern beech fern has recently been found to occur in the Libby Creek, Little Cherry Creek, and Bear Creek drainages. This species is considered very rare in the area and the nearest known populations are in Glacier National Park (Bratkovich, A., pers. comm. with P. Davis, August 15, 1990). The Little Cherry Creek population would be destroyed by construction of the tailings impoundment.

A small population of woolgrass—classified as critically imperiled in Montana by the Montana Natural Heritage Program, would be destroyed by the tailings impoundment. Other vegetation types which would be affected by the proposed project are neither unique nor uniquely valuable. The areas proposed for disturbance represent very small portions of large acreages of these vegetation types which are widespread throughout the region. The proposed project would result in no known impacts to any threatened or endangered vegetation species.

Soil Productivity

Soil impacts are closely related to vegetation impacts. Impacts to the soils resources would be unavoidable, but these impacts can be minimized with proper reclamation and resource management. Given successful reclamation, long-term impacts to soils would be minimal.

Impacts to soils would include erosional losses, destruction of natural soil profiles and other physical alterations, and reduction in biological activity. Erosion control measures have previously been discussed. The most important aspect in minimizing other physical impacts would be to minimize soil compaction during reclamation. Vegetation will not thrive in compacted soils. Once vegetation is successfully established, natural soil forming processes would slowly begin to re-establish soil profile development.

Soil fertility can be managed in the short-term with inorganic fertilizers. In the long-term, re-establishment of natural nutrient cycling ability of the soil would mitigate a temporary decrease in soil productivity resulting from stockpiling of soils. Stockpiling would also result in the reduction of viable biological soil components, including seeds, plant roots capable of growth, and beneficial micro-organisms. With successful vegetation establishment and post-reclamation management, the biological activity of the soil would be eventually restored.

Soil Loss

The control of soil erosion would be important during operations and during final reclamation. Erosion impacts may include deterioration of air and surface water quality, addressed in detail elsewhere in this chapter. Other impacts include soil loss and more difficulty in revegetation.

Most of the soils suitable for reclamation formed in volcanic ash, and are typically high in silt content. These soils are moderately susceptible to wind and water erosion. Increased rates of soil erosion relative to natural erosion rates would result from soil salvage and replacement operations. During operations, soil loss and sediment yield would be mitigated several ways. First, mixing of salvaged soils would increase rock fragments on the soil

surface. Rock fragments lower susceptibility to erosion by increasing the amount of surface cover provided by rock. Disturbed soils would then be further stabilized by interim revegetation measures. Finally, diversion structures, and other drainage and sediment control structures would control surface flows and reduce sediment yields.

Transmission Line Impacts

Minor to moderate soil compaction would occur as a result of constructing the transmission line, substations and microwave repeater station. Soil compaction can result in decreased water infiltration and poorer soil aeration. Seedling emergence can also be reduced by compaction. Most soil compaction results from the first two or three passes of heavy construction equipment. The degree of soil compaction depends on soil moisture, texture, and amount of plant root mass in soil. Noranda would till soils prior to revegetation. Deep tillage (or ripping) would reduce compaction on deeply compacted temporary road surfaces.

Rutting would likely occur if construction were to take place when fine-grained soils are wet. Some soil loss due to erosion would also occur during transmission line construction. Revegetation following construction would minimize long-term erosional losses.

Certain natural conditions would pose constraints in the design and construction of the transmission line. Proper attention during line design would avoid problems such as slope instabilities on road cuts and inadequate structural support on fine-grained soils low in bearing strength.

Figure 4-5 shows the location of each alternative transmission line route. The amount of surface disturbance from road construction and stringing operations for each alternative transmission line route is shown in Table 4-27. The proposed alignment would result in more ground disturbance and increased soil erosion than any of the other alternative alignments. Other alternatives would entail the use of helicopters for stringing, thus reducing surface disturbances from transmission line construction.

From the Sedlak Park substation, all identified alternatives coincide as they extend north approximately four miles along the Fisher River. Much of this segment is located on steep sideslopes in highly erodible lacustrine silts and clays. A logging road is located near the proposed alignment, but would not provide access to all structures. There would not be adequate access along the centerline for the stringing operation, and additional grading along the line would be required. The potential for erosion is considered moderate to high where new road and line stringing access would be needed on the steep sideslopes. Erosion potential would be low for structures on the nearly level valley floor and where existing access is adequate.

The last two or three structures where the line turns to cross the Fisher River and U.S. 2 would be located on slopes of about 60 percent. Successful revegetation on these slopes would be critical to reducing soil erosion. Line stringing could require a leveled area up to 150 feet by about 50 feet. Smaller disturbance would result if a turn-out on the haul road could be used for stringing operations.

From the Fisher River crossing to the divergence of the North Miller route (Alternative 5), the route crosses the base of south-facing slopes in two areas with highly erodible silts and clays. Slopes along this segment range from nearly level to over 40 percent, but most are less than 20 percent. New access roads would be built to about five of the 18 structures in this portion of the route. Line stringing by crawler tractor would require a leveled surface on a sideslope for about 0.7 mile. Temporary access roads would be subject to increased soil erosion until vegetation is re-established.

The steepest terrain is located in the head of the Miller Creek drainage. Existing roads would be used for access to only three of 23 structures. Along the portion of line from the bottom of Miller Creek over

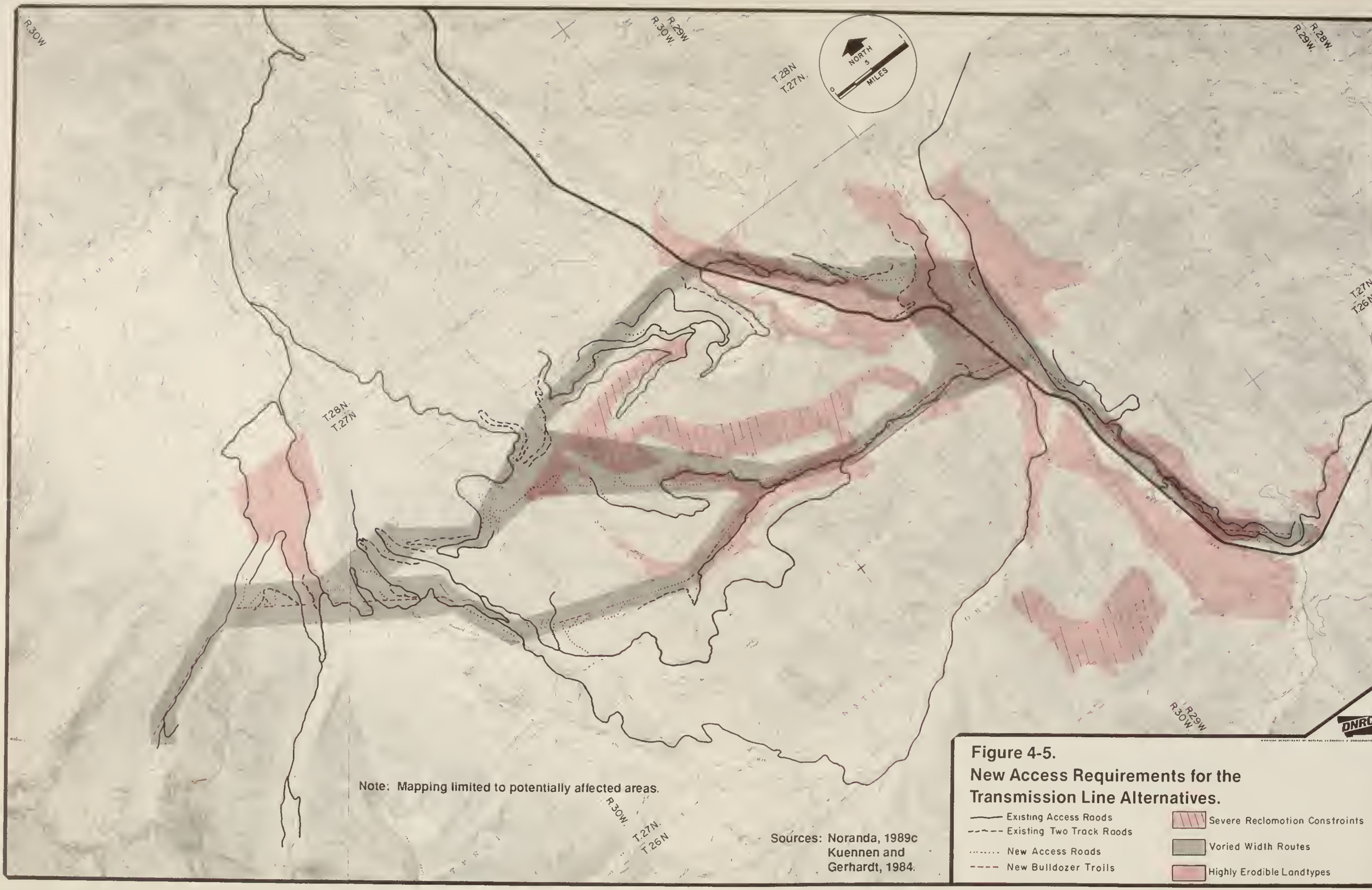


Figure 4-5.
New Access Requirements for the Transmission Line Alternatives.

the divide to a point 0.25 mile southeast of Howard Lake. A graded trail would be required for line stringing over most of this segment because the sideslopes exceed ten percent. Soils at the lower elevations in Sections 21 and 22, T27N R30W, are easily eroded and prone to landslides (Figure 4-5). Increased erosion would result from access road construction for line construction and stringing operations.

From Howard Lake to the Libby Creek crossing, the proposed alignment would cross sideslopes in the 10 to 40 percent range. Existing roads would provide access to about nine of 19 structures. Access road spurs would have to be constructed to at least five and as many as nine of the remaining structures, increasing the possibility of erosion.

All alignment alternatives coincide between the crossing of Ramsey Creek and the mine site. This segment would be located mostly on slopes of less than 40 percent. The existing Ramsey Creek road would provide access to all but four of the structures. Leveling would probably be required on sideslopes greater than 10 percent for line stringing, and this excavation would result in some soil loss.

Reclamation

The stated long-term objective of Noranda's proposed mine reclamation plan is "to establish a post-operational environment that is compatible with existing and proposed land uses of the area...consistent with the [Kootenai National] Forest Plan." Specific goals of the reclamation plan include—

- re-establishment of biological potential suitable for supporting vegetative cover appropriate to the area;

Table 4-27. Estimated miles of new road and number of stringing sites for the alternative routes.

Slope range	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	—miles of new roads crossing highly erodible land types—			
0-10%	0.00	0.00	0.00	0.00
11-20%	1.02	1.02	0.64	0.00
21-40%	1.17	0.00	0.08	0.27
41-55%	1.33	0.00	0.00	0.00
>55%	0.61	0.00	0.00	0.00
	—miles of new roads crossing other land types—			
0-10%	0.00	0.00	0.00	0.00
11-20%	1.36	0.64	1.14	1.06
21-40%	6.61	3.84	2.20	2.35
41-55%	1.25	0.83	1.29	1.48
>55%	1.78	0.91	0.49	0.49
Total	15.13	7.24	5.84	5.65
Assumed stringing sites	7	7	8 to 10	7 to 8

Source: DNRC. 1990.
†Includes road construction for pole placement and access for crawler tractor stringing operations where required on side slopes greater than 10%. Total access requirements for stringing tractor on slopes greater than 10% is estimated to be 7.59 miles.

- restoration of wildlife habitat; design of a land configuration compatible with the watershed; and
- re-establishment of an aesthetic environment allowing for visual quality and recreational opportunity.

Mine facilities. Noranda has committed to salvaging and replacing soils on most disturbed areas in the mine area. Soils would not be salvaged and replaced for the mine access road and facility corridors or at proposed soil stockpile areas (see Chapter 2). Enough soil would be salvaged to ensure successful reclamation.

Disturbed areas would be graded to achieve planned post-mining topographic configuration and drainage patterns. Stockpiled topsoil would be redistributed onto graded areas. Applied fertilizer would be incorporated into the soil by tillage as part of seedbed preparation. On slopes too steep for tillage equipment, fertilizer and mulch would be sprayed on in a liquid slurry. Soil tests would be conducted on regraded soils to determine fertilization requirements.

Although the use of inorganic fertilizers can compensate for decreased natural fertility in stockpiled soils, too much fertilizer can depress the re-establishment of biologically catalyzed nutrient cycling, creating an unwanted fertilizer dependency in newly established vegetation. Fertilization might also favor establishment of certain non-native grass species over native species. It is difficult to predict these types of responses reliably.

Two revegetation species mixes have been developed (Tables A-1 and A-2, Appendix A). Both mixes would be intended to result in a coniferous forest vegetation type with an understory of shrubs, grasses and forbs. One mix would be specifically intended for cool, moist sites; the other would be more broadly adaptable to most other growing conditions. Each mix would contain both native and non-native species.

Seed would be drilled on prepared sites at a rate of 90 to 100 pure live seeds per square foot. This rate would be doubled for broadcast seeding on steeper slopes. With adequate moisture, these mixtures sown at these rates would be expected to produce a fairly rapid establishment of herbaceous cover. Woody species would be planted in densities averaging over 600 plants per acre, in proportions of about 70 percent tree species and 30 percent shrub species. Noranda anticipates achieving a 65 percent survival rate for trees after 15 years. Woody species would be planted in a relatively even density in some areas and in denser islands or clusters in other areas. Selection of areas for varied planting densities of woody species would enhance landscape diversity.

Monitoring and management of revegetated areas following revegetation would be essential to successful project area reclamation. Noranda's monitoring plan (Chapter 2) would be adequate to determine the effectiveness of the revegetation plan.

Noranda has proposed increasing the width of the present Bear Creek Road and two other roads up to 29 feet. This widening would require suitable road base. Noranda has no developed detailed plans for procuring this material; studies are proposed to evaluate the material in the proposed borrow area at the tailings impoundment site. If additional disturbance is required to obtain this material, Noranda would have to conduct additional environmental studies and the agencies would complete additional environmental analysis and documentation.

Tailings impoundment. Immediately after cessation of tailings deposition, the surface of the impoundment would most likely be comprised of a relatively firm and dry tailings sand beach, a relatively soft and saturated slimes surface and an area of pond water towards the back of the impoundment (decant pond) (Vick, 1983). In order for the proposed reclamation and stabilization efforts (such as regrading, placing topsoil and revegetation) to be accomplished, the entire impoundment surface must be sufficiently firm to support the necessary equipment. The amount of drying time necessary to achieve this degree of firmness would vary greatly over the impoundment sur-

face, depending on the nature of the tailings, size of the pool and climatic conditions. Surfaces composed of coarse tailings sands may be sufficiently dry and firm within several days, whereas zones of slimes may require a drying period lasting a year or more, especially in the vicinity of the decant pond. Drying of the decant pond would be accomplished via drainage and evaporation.

Consolidation and settlement of the tailings would occur as excess pore water pressures within the tailings are dissipated (Nelson et al., 1983). Continuing drainage of the tailings would result in lowered water content and pore water pressure. Consolidation could also be accelerated by placement of a relatively thick cover comprised of compacted soil or mine waste materials. Settlement of the coarser tailings zones would occur quite rapidly since excess pore pressures dissipate quickly in these materials. However, desiccation and consolidation of the slimes surface may require considerable time. Studies by Krizek et al. (1977) involving 2- to 3-meter thick (6.6 to 9.8 feet) surficial layers of dredged fill indicated that settlements of about 0.2 to 0.4 meter (0.7 to 1.3 feet) required about 250 days. Complete consolidation of the slimes would probably take several months to several decades, depending on the vertical thickness. Maximum consolidation settlements of the tailings surface are anticipated to be about 10 percent of the vertical thickness, ranging from a few inches at the impoundment edges to between 20 and 30 feet at the thickest deposit.

Without adjustments to the tailings surface during reclamation, direct precipitation and resulting runoff on the impoundment surface and runoff from the limited watershed above the impoundment would tend to collect in the decant pond area. If the surface remains unaltered, this former pond area would be concave and a continual recharge point for the impoundment. Because of the heterogeneous nature (both horizontally and vertically) of the tailings deposit, differential settlements of the impoundment surface would probably occur, resulting in minor surface undulations and localized ponding of direct precipitation and any runoff impacting the surface. However, the magnitude of recharge and resaturation of impounded tailings resulting from this localized ponding would be very small when compared to the recharge via runoff concentrating within the decant pond area depression.

The initial reclamation efforts proposed by Noranda are directed toward minimizing the quantity of surface runoff impacting the pond area by grading the impoundment surface to drain direct precipitation and runoff. Contouring and regrading of portions of the tailings surface would prevent the collection of surface runoff in the pond area. Contouring of the surface would also serve to minimize the small amount of recharge occurring within localized areas subjected to differential settlements. Noranda proposes to cover the impoundment with waste rock prior to topsoil replacement. Adequate waste rock would likely be available from adit construction and mine development.

The contouring and regrading activities proposed by Noranda could be accomplished in an incremental fashion as areas of the impoundment become accessible by equipment. Each area would be graded and contoured to promote drainage of surface runoff to the impoundment perimeter. Topsoil would be placed on each area and revegetated.

Acid formation is not expected to adversely affect reclamation efforts. Although the ore body contains a small percentage of sulfides, analyses conducted by Noranda indicate that tailings would not be acid forming. Noranda proposes to conduct additional testing of tailings and waste rock prior to reclamation.

A 24-inch thick soil cover would be placed on the tailings impoundment dam; 18 inches would be used on the impoundment surface. Tests indicate that coarse tailings underlying the soil cover would be physically and chemically suitable as a plant growth medium. If additional analyzes of the tailings physical and chemical characteristics confirm the

baseline analyses, long-term revegetation success would be expected.

Transmission line. Existing vegetation would be removed for construction of access roads, for leveling working areas near sites, for pole installation or line stringing, for possible trenching to install counterpoise ground wire, and for grading sideslopes for the bulldozer path to string conductors (see Table 4-21, Wildlife section, for acres of coniferous forest affected). Vegetation removal and grading may not be required on level or gently sloping ground or where an existing road can be used. Limited topsoil removal may occur during access road construction. Topsoil would be placed alongside the road cut. Some road building in steep terrain would likely be required. Where cut-and-fill slopes would be required on steep slopes, these areas would not be covered with topsoil. Noranda has proposed using the Board of Natural Resources and Conservation's environmental specifications found in Appendix F.

Weed invasion and control. The disturbed soils created by construction activities would provide favorable sites for spotted knapweed, Canada thistle, and St. Johnswort. Canada thistle also might invade cleared areas. The seeds and other reproductive parts of these weeds could cling to construction vehicles and be spread along the transmission line and access roads.

The spread of weeds is unavoidable; enforcement of or compliance with the County Noxious Weed Control Act would help to limit the spread. Where project facilities disturb Champion lands, either Champion or Noranda would be required to prevent weeds from propagating or going to seed or to develop an effective weed control plan, subject to the county weed board's approval. Under the terms of the transmission line right-of-way agreement, Champion could choose to hold Noranda responsible for weed control. Noranda would be responsible for preventing weeds from propagating or going to seed or developing an effective control plan for lands it disturbs within the national forest.

Weed control plans submitted to the weed board also require agencies' approval. If the plans are not approved by the agencies, the agencies can require separate plans for weed control. After the transmission line is built, agency and weed board representatives would monitor weed infestations. If necessary, the weed control efforts would be modified or intensified.

Implementation of the revegetation plan and early detection of infestations and treatment would be key elements of Noranda's weed monitoring and control program on private lands. All herbicide applications would be made in accordance with approved materials and methods under the supervision of licensed applicators as required by law. Effective management of a weed control program as proposed by Noranda would minimize weed infestation on lands disturbed by mining. Use of herbicides on KNF lands would require more specific information and additional environmental analysis.

ALTERNATIVE 2

Noranda would institute a sampling program to monitor acid formation from the waste materials. This would entail analysis of waste rock and tailings to determine and monitor acid-base potential. These materials also would be sampled as they weather, if appropriate, to ensure that acid problems would not develop. Appropriate treatment measures would be taken as required in accordance with monitoring results. This measure would ensure acid-generating materials would not affect surface or ground waters or adversely affect revegetation.

The Bear Creek Road from U.S. 2 and the Bear Creek Bridge would be returned to its pre-mine width, unless the KNF should want a wider road. The 22-acre disturbance associated with the road would be reclaimed.

ALTERNATIVE 3

Noranda would treat excess water using either a wetland treatment system or a mechanical system prior to discharge. The percolation ponds may not be constructed, reducing the amount of disturbed area. Soil erosion during construction and operation of the ponds would not occur. Other impacts described under Alternative 1 would occur.

ALTERNATIVE 4

Noranda would use a helicopter rather than a crawler tractor during initial stringing operations. Conventional transmission line construction equipment would be used to complete stringing operations (see Figure 2-15). Up to seven miles of graded access for line stringing would be eliminated, reducing possible erosion and revegetation problems. All other impacts would be the same as described for Alternative 1. Alignment changes in the vicinity of the Libby Creek Recreation Gold Panning Area would require an additional 0.5 mile of access roads for equipment, but this would result in the reduction of impacts to recreation at this site.

ALTERNATIVE 5

Portions of the Alternative 5 route coincide with and would cause the same impacts as Alternative 4. Alternative 5 diverges from Alternatives 1 and 4 to follow about 1.5 miles along an unnamed intermittent stream to the divide between Miller and Midas creeks. Existing access to most structures sites on this segment is poor, and would require new access roads. About half of these roads would be on steep slopes. The southernmost half mile of this segment crosses highly erodible soil. This material also is prone to mass movement. Access roads would have to be located carefully to avoid causing long-term erosion and sedimentation.

Slopes in the southernmost half of this segment are about 10 to 15 percent, while slopes nearer the divide exceed 40 percent. Soils on the south-facing slopes near the Miller Creek-Midas Creek divide are shallow and may prove difficult to revegetate. Access roads would be required to access four structures located in an area mapped by the KNF as having poor reclamation potential.

Near the divide between Miller and Midas creeks, Alternative 5 and Alternative 6 converge and then coincide as they cross a ridge line and proceed downhill to join the proposed alignment of other alternatives near the crossing of Libby Creek. Slopes along this segment are generally in the 20 to 40 percent range. The first 0.7 mile of the segment closely parallels an existing road which could be re-opened and used for construction access. On the portion of the segment in the Howard Creek drainage, existing roads could provide access to about three of seven structures. Short-term increases in erosion could occur until revegetation is successful on new access roads.

Alternative 5 would require fewer new access roads than Alternatives 1 and 4 but more than required for Alternative 6. Alternative 5 also would require more roads on highly erodible soils than Alternatives 1, 4 or 6, and is the only alternative that would disturb areas identified by the KNF as difficult to reclaim.

ALTERNATIVE 6

Alternative 6 coincides with all alternative routes for the first four miles of line north of the Sedlak Park substation. Alternative 6 continues north about one mile over gently sloping hills composed of silt before turning northwest and crossing the Fisher River. New roads would be needed to two structures in this segment, while an existing road would serve four structures and cross country access would be used for one additional structure. Short-term increases in erosion would likely result until disturbances are revegetated.

After crossing the Fisher River, the route first crosses a short, steep slope and then proceeds about 1.5 miles across a relatively flat bench. Existing roads would provide access to about four of ten structures, and two to three structures located on flat

ground could be reached by traveling overland. After traversing the bench, the proposed segment is located in a swale as it proceeds north and drops in elevation before reaching U.S. 2.

After crossing U.S. 2, the route turns west across moderately steep to steep slopes before reaching the Swamp Creek-Midas Creek divide. This area has been extensively logged and existing roads would provide access to about 11 of 20 structure sites. Short spur roads would be needed to reach the remaining structures, and these would result in some short-term erosion.

After crossing the Swamp Creek-Midas Creek divide, Alternative 6 crosses 600 feet of very steep slopes. One structure probably would be located in this steep area, and a 400-foot spur road from an old logging road would be required. Fairly extensive roads would be required on steep slopes in the last 0.5 mile of this segment; short-term erosion would occur until revegetation is successful.

Near the Swamp Creek-Midas Creek divide, the line would remove about five acres of old growth timber.

The impacts on segments from Howard Creek to the mine substation would be the same as for the other alignment alternatives.

ALTERNATIVE 7

Soil and vegetation resources would not be affected. Increased erosion would not occur and the areas of wetlands and old growth timber would not be disturbed.

CUMULATIVE IMPACTS

The cumulative impacts of all alternatives are similar. The ASARCO Rock Creek Project, the Montanore Project, and proposed timber sales in the Montanore Project area would result in disturbance of 3,404 acres. Clearing of vegetation and increased soil erosion would result from this disturbance. The Rock Creek Project, however, would affect a different watershed. Implementation of Best Management Practices for Forestry would reduce the amount of soil lost as a result of logging.

RESOURCE COMMITMENTS

Small areas of wetlands and old growth timber would be irretrievably lost. If seeps emerge from the perimeter of the tailings impoundment, some wetlands may become reestablished. Timber removal prior to facilities construction would accelerate timber production in the area. Some timber production may be lost from continued clearing of the transmission line. Following successful implementation of the revegetation plan, vegetation production and cover would eventually reach pre-mine levels. Increased shrub cover would occur in areas cleared for the transmission line. Some locations, such as areas with steep slopes or shallow soils, may not be successfully revegetated, and the vegetation production in these areas would be reduced.

Some soil would be lost during construction and prior to reestablishment of vegetation. Minor deleterious effects on soils would result from prolonged stockpiling, but following soil replacement, soils would reach pre-mine productivity levels over time.

LAND USE

SUMMARY

Land uses in the project area include wildlife habitat, recreation, timber harvesting, mineral development and range. Direct land use impacts would be localized and occur as a result of construction of surface facilities, access roads and the transmission line. Permit areas around the facilities would be about 4,200 acres, of which 1,225 acres would be disturbed. Land uses in Libby and surrounding areas would likely be affected by new residential and commercial development occurring as an indirect effect of mine development.

About 37 percent of lands crossed by the proposed transmission line are classified as transmission line corridor avoidance areas. The transmission line would pass within one-quarter mile of six residences and two developed recreation areas.

Reclamation would result in the reforestation of some disturbed lands. The 729-acre tailings impoundment area and the 22 acres associated with the Bear Creek access road would not be capable of supporting pre-mining uses. Some areas may not be successfully revegetated, resulting in reduced productivity. Noranda would work with the KNF to develop appropriate management for the tailings impoundment following operations.

Under Alternative 2 and 3, Noranda would restore the Bear Creek Road to its pre-mining width. The KNF would amend the Forest Plan for the 729-acre tailings impoundment area to MA 31—Mineral Development. MA 31 would not be suitable for timber production.

Less surface disturbance would occur under Alternative 3. Disturbance of 78 acres for the percolation ponds, proposed for an area currently managed for grizzly habitat, would not occur. Either a wetland or a water treatment plant would be constructed on private land near the proposed tailings impoundment.

Transmission line impacts associated with Alternative 4 would be similar to Alternative 1. Less land classified as corridor avoidance areas would be crossed by Alternatives 5 and 6. The KNF would amend the Forest Plan for areas classified as corridor avoidance areas under Alternatives 4, 5, and 6 to MA 23—Electric Transmission Corridor. Alternative 5 would pass within one-quarter mile of six residences and Alternative 6 would pass within one-quarter mile of eight residences; both alternatives would pass near a developed recreation area. No changes in land use would occur under Alternative 7

ALTERNATIVE 1

During the life of the operation, use of the lands disturbed by the project would be devoted to mining and associated activities. The permitted area would total 4,209 acres; 1,225 acres would be actually disturbed. Adjacent land use during the operation would be affected to some extent—these impacts are described in other sections on recreation, noise, visual resources and wildlife. Access to some areas outside actual disturbed areas would be restricted during the years of operation. Timber sales and

harvests would continue in the area if grizzly bear habitat would not be adversely affected.

The Ramsey Creek plant site and the percolation ponds would be located entirely on national forest lands administered by the KNF. These lands are currently used primarily for wildlife habitat, recreation, commercial timber production, mineral development and range. They are managed under multiple use guidelines in accordance with the KNF Forest Plan (Kootenai National Forest, 1987). The plant site would be located in Management Area (MA) 2—Semi-primitive non-motorized recreation. The goal of this MA is to provide for the protection and enhancement of areas for roadless recreation use and to provide for wildlife management where specific wildlife values are high. The semi-primitive recreational opportunities in upper Ramsey Creek would be significantly affected by the plant and associated traffic (see Recreation section). The area has a high value as grizzly bear habitat (see Wildlife section).

The proposed percolation pond areas would be in MA 14, managed specifically for grizzly bear habitat. The percolation ponds and associated facilities would disturb nearly 80 acres of this habitat. Facilities which require frequent maintenance or occupancy normally are not allowed in MA 2 and 14. Activities associated with mineral development, however, are allowed in MAs 2 and 14 under the Forest Plan.

The Libby Creek adit area is a patented mining claim. The adit would not affect surrounding land uses.

A portion of the impoundment would be on private land (356 acres). The remaining portion of the tailings impoundment would be located in MA 14, with a small portion (~25 acres) affecting MA 13, Designated Old Growth Timber.

A small livestock grazing allotment occurs within the project area. Although this allotment would not be directly affected, increased traffic and increased population might lead to increased poaching of livestock. Given the small size of the allotment (30 head of cattle), any livestock loss as a result of the project could adversely affect the livestock operation.

Most lands disturbed by mining would be revegetated. The Bear Creek Road from U.S. 2 to the Bear Creek bridge would not be restored to its pre-mining width. Successful reclamation would result in reforestation of disturbed lands. The goal of reclamation would be to restore lands to productive use (see Soils, Vegetation and Reclamation section). The 729-acre tailings impoundment area and the 22-acre disturbance associated with the upgrade of the Bear Creek Road would not be capable of supporting pre-mining uses. Timber harvest would be restricted on the impoundment. Noranda proposes to return the access road from the Bear Creek bridge to the plant site to its pre-mining width unless the KNF desires a wider road. The access road from the Bear Creek bridge to U.S. 2 would be left as a 20 to 29-foot road. Responsibility for road maintenance would return to the KNF following project completion.

Other areas, over time, would return to pre-mine uses and productivity. At the end of mining, the transmission line would be removed. The BPA would remove the substation and microwave repeater unless other uses occur at project completion. Areas associated with the transmission line would be revegetated.

Noranda has proposed that the KNF implement year-round closure of three National Forest System roads (10.9 miles) and seasonal closure of four National Forest System roads (20.1 miles). The KNF has two of these roads (5.8 miles) under consideration for permanent closure. Road closures would reduce motorized access on the east side of the Cabinet Mountains (see Recreation section).

Special Management Area

The tailing impoundment area would be reforested. Because the reclaimed impoundment site would incorporate permanent structures such as the tailings dam and diversion channel, special considerations

would be needed to ensure permanent integrity of this site. Minimizing erosion on this site would be a critical consideration. Accordingly, Noranda has recognized in the permit application that such an area should be considered for designation by the KNF as a "special management area" having special provisions which would be incorporated in the KNF's Forest Plan.

Noranda would develop specific technical recommendations at the end of the project for KNF with regard to "special management" considerations of the reclaimed tailings impoundment area. These recommendations would provide measures to preserve the long-term integrity of the tailings dam and impoundment and would include appropriate erosion control monitoring and maintenance plans, and constraints for recreational uses, and timber harvesting. If timber harvesting were restricted on all disturbed areas associated with the impoundment, 729 acres of potential commercial timber stands would be lost.

Transmission Line

Affected land uses. All alternative routes cross Champion International forest lands along the Fisher River. Champion lands are managed primarily for timber; some dispersed recreation also occurs on Champion lands. Transmission line construction would require logging the powerline corridor, which is compatible with Champion's land management. Following construction, the transmission line could restrict cable logging in areas adjacent to the line.

The remaining 9.5 miles of Alternative 1 are on KNF lands (Table 4-28). Six miles of the line (363 acres) would cross land that the KNF has identified as corridor avoidance areas because transmission line-related impacts would be difficult or impossible to mitigate (Table 4-29). Although not proposed by Noranda, a Forest Plan amendment (Appendix E) would be necessary to make this alternative consistent with the Forest Plan. About 84 percent of land (13.7 miles) on this route is in management areas suitable for timber production, of which about 18 percent (2.9 miles) is logged (Figure 4-6).

The route would pass within one-quarter mile of six residences and two recreation areas—Howard Lake Campground and the Libby Creek Recreation Gold Panning Area. There are no mechanically irrigated lands within 1,000 feet of the proposed line.

To provide for monitoring of the Sedlak Park transmission line substation, a passive microwave repeater site would be constructed on a ridge near Barren Peak about three miles west of Sedlak Park (see Figure 4-6). This station, which would resemble a billboard, would require about a quarter acre of cleared land. Because the repeater would be installed using helicopters, no additional clearing for access roads would be necessary.

The repeater would consist of a reflective panel approximately 30 feet tall by 40 feet wide. It would be located on KNF lands that have forest Regeneration Problems (MA 18) or are managed for Grizzly Habitat (MA 14). Facilities which require frequent maintenance or occupancy normally are not allowed in these areas. The microwave repeater would need to be inspected approximately once a year. The Barren Peak area is not identified in the Forest Plan as a communications site and may require KNF action to designate this area as an electronic site. The impacts of the Barren Peak communication site are common to all alternatives.

Roads have been built in connection with logging and mineral exploration along Fisher River, Miller Creek, Howard Creek, and Ramsey Creek. U.S. 2 along Fisher River is a major all-weather paved highway. The Miller Creek, Howard Creek, and Ramsey Creek areas are accessible on Forest Service roads which are only plowed for wintertime logging or mineral development. Under Alternative 1, the Bear Creek road would have improved wintertime access, but approximately 5.6 miles of the transmission line would be beyond the plowed wintertime access areas (Figure 4-7). All

Table 4-28. Management emphasis of lands affected by the transmission line routes.

Land manager/ management emphasis	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	miles crossed by each alternative			
KNF Lands–Corridor avoidance areas				
MA 2–Semi-primitive non-motorized recreation†	1.7	1.7	1.7	1.7
MA 6–Developed recreation†	0.6	0.5	0.4	0.4
MA 12–Big game summer range§	2.2	2.2	0.0	0.0
MA 13–Designated old-growth timber†	0.5	0.5	0.4	0.5
MA 14–Grizzly habitat†	1.0	1.0	1.1	1.1
MA 19–Steep lands†	0.0	0.0	0.0	0.2
Subtotal	6.0	5.9	3.6	3.9
KNF Lands–Corridors permitted				
MA 11–Big game winter range	1.8	1.8	2.4	2.3
MA 12–Big game summer range§	0.0	0.0	0.0	1.7
MA 15–Timber production	1.7	1.9	1.5	1.8
MA 18–Regeneration problem areas†	0.0	0.0	1.4	1.2
Subtotal	3.5	3.7	5.3	7.0
Private lands				
Champion International	7.0	7.0	7.0	5.8
Other private	0.0	0.0	0.0	0.4
Subtotal	7.0	7.0	7.0	6.2
Total	16.3	16.4	15.9	17.1

Source: Department of Natural Resources and Conservation. 1990.
†These are areas designated in the KNF Forest Plan where timber production is not a suitable activity.
§This MA is a corridor avoidance MA only in grizzly situation 1 and 2 areas.
Totals may not add due to rounding.

Table 4-29. Management Areas proposed for amendment to Management Area 23.

Management Area	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	acres affected by each alternative			
MA 2–Semi-primitive non-motorized recreation	103	103	103	103
MA 6–Developed recreation	36	30	24	24
MA 12–Big game summer range§	133	133	0	0
MA 13–Designated old-growth timber	30	30	24	30
MA 14–Grizzly habitat	61	61	67	67
MA 19–Steep lands	0	0	0	12
Total	363	357	218	236

Source: Department of Natural Resources and Conservation. 1990.
§This MA is a corridor avoidance MA only in grizzly situation 1 and 2 areas.
Based on a 500-foot right of way or 60.61 acres per mile of transmission line; totals may not add due to rounding.

Figure 4-6.
Land Uses and Ownership Along the Transmission Line Alternatives.

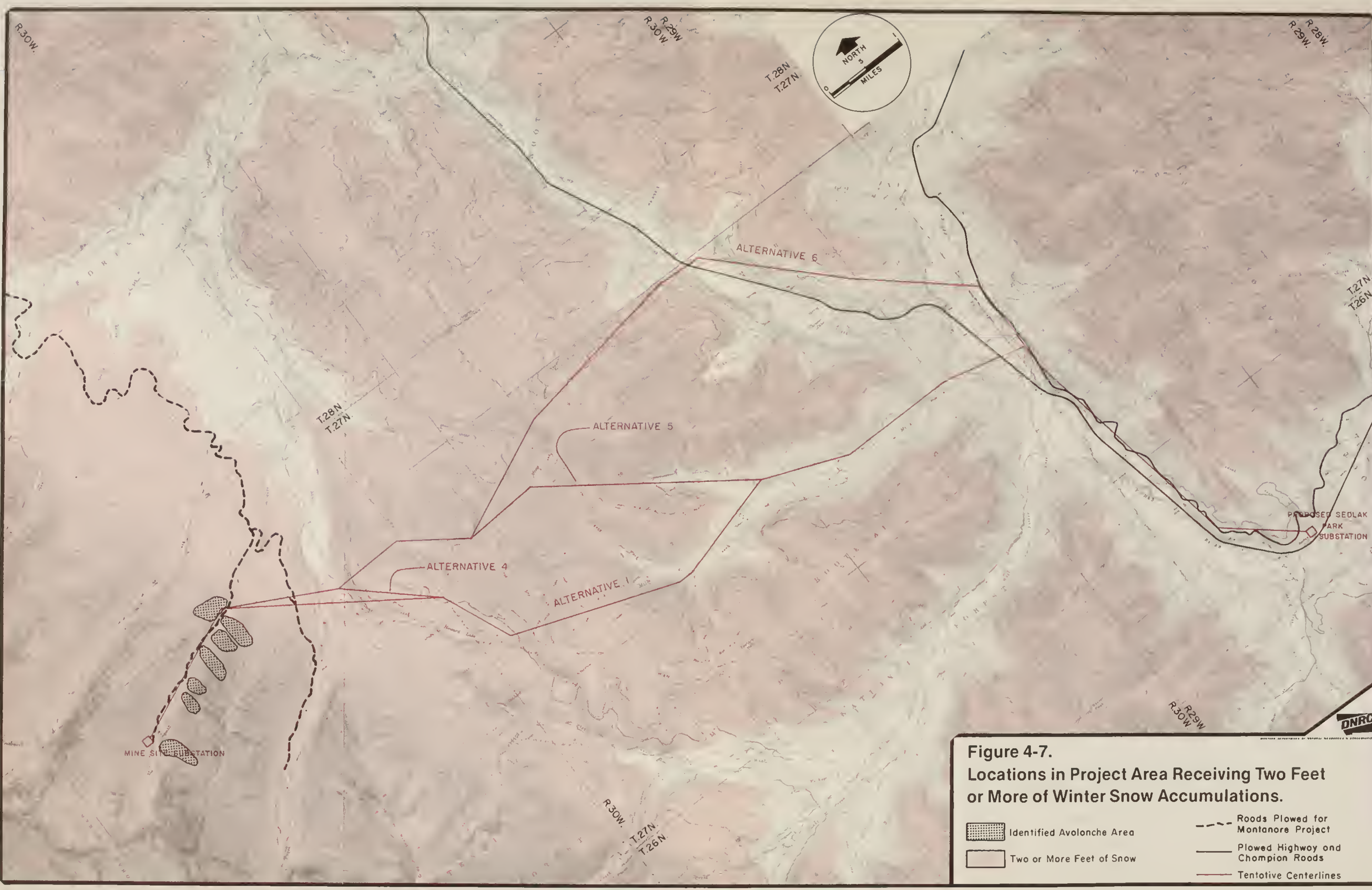


Figure 4-7.
Locations in Project Area Receiving Two Feet or More of Winter Snow Accumulations.

transmission line alignment alternatives would require crossing about 1,000 feet of area prone to avalanches at the mouth of the Ramsey Creek canyon (Figure 4-7).

Future timber harvests are expected on Champion International lands along Fisher River and lower Miller Creek. The KNF has two timber sales scheduled in the 1990s (total of 14 million board-feet on 700 acres) that would be affected by the transmission line (D. Crawford, Libby District Timber Resource Staff, written comm. with R. Trenholme, November 30, 1989). These sales would require an estimated 5.5 miles of new road construction and three miles of improvements on existing roads. The proposed transmission line would eliminate logging within the 100-foot cleared right-of-way and would restrict use of some special logging equipment (cables, jammer poles) near the line where use of such equipment would pose a safety hazard.

Alternative 1 would require clearing of about 172 acres in areas managed for timber, and 43 acres in areas managed for natural values. This clearing would produce an estimated 4.3 million board-feet of timber. About 37 acres would be dedicated to road access for line maintenance over the life of the project. Some of these roads might be useful for other activities and could remain in place after operations.

Access road construction. Alternative 1 would require construction of about 12.6 miles of new access roads or trails in areas identified in the Forest Plan as being suitable for timber harvest (Table 4-30). About 25 percent of new transmission line roads also would provide access to timber sale areas reducing the amount of road construction needed during logging. Approximately 2.5 miles of new road would be constructed in areas managed for recreation, old growth, and forest habitats and soil protection. New roads in these areas are discouraged by the Forest Plan. Alternative 1 would require road access into currently roadless portions of the upper Miller Creek drainage.

Indirect Impacts

Some land use changes may occur as a result of the Montanore Project. As discussed under Socioeconomics, some in-migrating employees and their families would require additional housing. Limited new commercial activity would also result from the project. The vast majority of this housing and commercial business development would occur in areas already dedicated to that type of use. Development patterns are constrained by availability of infrastructure, floodplain, land ownership, and steep topography. Existing patterns of growth and development in the Libby area include—

- major residential development east of Libby, south along U.S. 2, and north across the river in scattered subdivisions;
- a commercial city-center in Libby;
- major commercial strip development along U.S. 2; and

Table 4-30. Miles of road construction needed by the transmission line routes.

Land type	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	miles of new road constructed			
Suitable logging areas	12.6	4.8	2.1	2.7
Natural areas (no logging)	2.5	2.5	3.7	2.9
Total	15.1	7.3	5.8	5.6

Source: Department of Natural Resources and Conservation. 1990.

- limited off-highway commercial center development in the western part of Libby.

These general patterns would readily incorporate any additional residential and commercial development resulting from the Montanore Project.

As discussed in the Socioeconomics section, most of the long-term operations workforce is expected to locate outside the city of Libby. With an overall long-term influx of an estimated 58 families into rural Lincoln County, it is possible that new subdivision development may occur at some point in the future to meet a specific market demand. In the short-term, however, it is more likely that these families would locate into existing residential land use areas. It is impossible to forecast where any specific new development might occur. It is reasonable to assume that a new subdivision of 20 to 30 homes (or 20 or 30 new homes in scattered areas) would convert 10 to 15 acres of land near Libby to residential use.

With the current state of the local economy and patterns of commercial development, it is unlikely that Montanore Project development would cause any major conversion of land to commercial uses. While it is likely that business would expand in the Libby area due to Montanore Project development, there is sufficient capacity in existing commercial areas to accommodate any new commercial development.

ALTERNATIVE 2

The KNF would amend the Forest Plan (Kootenai National Forest, 1987) for the proposed tailings impoundment area. The new management area, affecting the tailings impoundment area (729 acres), would be MA 31–Mineral Development. Management Areas are discussed in more detail in Chapter 3, Kootenai National Forest Management. The goals and objectives of MA 31 are described in Appendix E.

Noranda would return the Bear Creek Road from the Bear Creek bridge to U.S. 2 to its pre-mine width, unless the KNF should want a wider road. Successful revegetation of the 22 acres associated with this disturbance would restore pre-mine productivity and use.

Under the agencies' proposed grizzly bear mitigation plan, no roads other than those necessary to comply with the KNF Forest Plan would be closed. The KNF would, however, close Big Hoodoo Mtn. Road (#6747) to all motorized traffic during the winter season (December 1 to April 30) to reduce impacts to moose. These closures would restrict motorized access on the east side of the Cabinet Mountains (see Recreation).

Other impacts for Alternative 2 would be similar to those for Alternative 1.

ALTERNATIVE 3

Noranda would construct a either a wetland or a mechanical water treatment system near the tailings impoundment for treatment of excess tailings and mine water. This disturbance would likely occur on private lands. The 78 acres of disturbance associated with the percolation ponds may not occur. Other impacts for Alternative 3 would be similar to those for Alternatives 1 and 2.

ALTERNATIVE 4

Helicopter use for powerline stringing would reduce by half the amount of new access roads that would be required by Alternative 1 (Table 4-30). Line realignment near Libby Creek would avoid the developed portion of the Libby Creek Recreation Gold Panning Area. Effects to other areas classified as corridor avoidance areas would the same as Alternative 1.

The transmission line route crosses 357 acres designated as corridor avoidance areas in the KNF Forest Plan (Table 4-24). A Forest Plan amendment (Appendix E) would be necessary to make this alternative consistent with the Forest Plan.

The modified route would cross slightly more land suitable for timber production (Table 4-28). Considerably less new road construction is needed;

miles of road in natural areas, however, would be the same as Alternative 1 (Table 4-30)

Alternative 4 would require new forest clearing on 166 acres suitable for timber and 42 acres managed for natural values, yielding timber harvest of 4.2 million board-feet. About 38 acres would be taken out of production for the life of the project for transmission line maintenance roads.

Other impacts associated with Alternative 4 would be the same as those described for Alternative 1.

ALTERNATIVE 5

Along the Fisher River and lower Miller Creek, Alternative 5 would cross about seven miles of Champion International forest lands managed for timber production (Table 4-28). The route would pass within one-quarter mile of six residences, and one developed recreation area—the Libby Creek Recreation Gold Panning Area.

The transmission line route crosses 218 acres designated as corridor avoidance areas in the KNF Forest Plan (Table 4-24). A Forest Plan amendment (Appendix E) would be necessary to make this alternative consistent with the Forest Plan.

About 75 percent of the land crossed by this route (12.0 miles) is in management areas suitable for timber production, of which 23 percent (3.6 miles) has been logged already (Figure 4-6). Along U.S. 2 and the Ramsey Creek road (USFS road 4781), snow would be removed to maintain all-weather access. About 5.3 miles of transmission line along the Libby divide would be beyond the plowed wintertime access areas (Figure 4-7).

Future timber harvests are expected on Champion International lands along Fisher River and lower Miller Creek. The KNF has two timber sales scheduled in the 1990s (total of 14 million board-feet on 700 acres) that would be affected in the transmission line (D. Crawford, Libby District Timber Resource Staff, written comm. with R. Trenholme, IMS Inc., November 30, 1989). These sales would require an estimated 5.5 miles of new road construction and three miles of improvements on existing roads. The proposed transmission line would eliminate logging within the 100-foot cleared right-of-way and would restrict use of some special logging equipment (cables, jammer poles) near the line where use of such equipment would pose a safety hazard.

Alternative 5 would have the same impacts as Alternative 1 on residential and agricultural land use along the Fisher River. This route would require construction of about 2.5 miles of road in timber areas where about 15 percent of this distance could be used for future logging (Table 4-30). About 3.7 miles of new road would be built in areas managed by the KNF for natural values where land disturbance is to be avoided. These roads would provide increased access along the divide separating Miller and Midas creeks.

Alternative 5 would require new clearing of 131 acres managed for timber production and 56 acres managed for natural values, yielding a timber harvest of 3.4 million board-feet. About 31 acres would be removed from timber production to provide access for powerline maintenance over the 18-year life of the project. Some of these roads may be useful for other activities and could remain in place after the transmission line is removed.

ALTERNATIVE 6

Alternative 6 would cross about 5.8 miles of Champion International land, which is managed for timber harvest and recreation. About 0.4 miles of other private lands managed as a horse ranch and for agricultural uses would be crossed. This is the only alternative that would cross small private lands.

The remaining 10.9 miles would cross KNF land managed for multiple use under the Forest Plan (Table 4-28). About 77 percent of the land crossed by this route (13.1 miles) is in management areas suitable for timber production, of which 29 percent (5.0 miles) has been logged.

The transmission line route crosses 236 acres designated as corridor avoidance areas in the KNF Forest Plan (Table 4-24). A Forest Plan amendment (Appendix E) would be necessary to make this alternative consistent with the Forest Plan.

About 6.8 miles of Alternative 6 would be outside areas with plowed wintertime access (Figure 4-7). The route would pass within one-quarter mile of eight residences and the Libby Creek Recreation Gold Panning Area. This route would cross one corner of a flood irrigated field along lower Schrieber Creek and the Fisher River.

Future timber harvests are expected on Champion International lands along Fisher River and lower Miller Creek. The KNF has two timber sales scheduled in the 1990s (total of 14 million board-feet on 700 acres) that would be affected by the transmission line (D. Crawford, Libby District Timber Resource Staff, written comm. with R. Trenholme, November 30, 1989). These sales would require an estimated 5.5 miles of new road construction and three miles of improvements on existing roads. The proposed transmission line would eliminate logging within the 100-foot cleared right-of-way and would restrict use of some special logging equipment (cables, jammer poles) near the line where use of such equipment would pose a safety hazard.

About 3.1 miles of new road required for access on Alternative 6 would be in timber areas where about 15 percent of new roads could be used for logging (Table 4-30). The line would cross about 3.9 miles of lands managed for natural values areas where new roads pose particular land use or environmental impacts. Alternative 6 would increase access to the ridge line above Miller and Midas creeks.

This alternative would require new forest clearing of about 127 acres in areas managed for timber production, and about 57 acres in areas managed for natural values yielding a timber harvest of 3.7 million board feet. About 32 acres of roaded areas would remain unforested for transmission line maintenance access during the life of the project. Some of these roads may be useful for other activities and could remain in place after the transmission line is removed.

ALTERNATIVE 7

The land use impacts of the proposed project would not occur under this alternative except for those associated with the exploration adit on private lands in Libby Creek. Existing land use patterns on Champion International and Forest Service lands would continue, including recreation and timber harvesting.

CUMULATIVE IMPACTS

The cumulative impacts of all alternatives are similar. The ASARCO Rock Creek Project, the Montanore Project, and proposed timber sales in the Montanore Project area would result in disturbance of 3,404 acres, 2,904 acres of which would occur on the east side of the Cabinet Mountains. Motorized access would be restricted around project facilities.

Proposed road closures will restrict motorized access to 23 miles of National Forest System roads. These closures would reduce motorized recreational opportunity (see Recreation).

RESOURCE COMMITMENTS

Over half the land proposed for disturbance would not return to pre-mine uses. The tailings impoundment area, which would be managed for mineral development following operations, would no longer be suitable for timber production. Under Noranda's proposal, an additional 22 acres associated with the Bear Creek access road would not be reclaimed. The road would be returned to its pre-mine width under the other action alternatives, unless the KNF should want a wider road. Timber harvesting would be sooner in areas cleared for project facilities. Any indirect development associated with the project, such as new residential or commercial development in or around Libby, would likely be permanent.

RECREATION

SUMMARY

With development of the Montanore Project, recreational opportunities would generally remain abundant in the area and region. Increasing recreation demand in the Libby Creek drainage would significantly affect Howard Lake Campground and the Libby Creek Recreation Gold Panning Area. The wilderness experience of some individuals would likely be adversely affected by views of project facilities from several locations within the Cabinet Mountains Wilderness. Road closures would reduce motorized recreational opportunity and increase semi-primitive, non-motorized opportunity.

Under the remaining action alternatives, proposed mitigation, primarily increased recreation facilities development, would reduce the impacts to the developed recreational areas from mine-related developments. The transmission line would be rerouted to avoid the Libby Creek Recreation Gold Panning Area. No recreation impacts would occur under Alternative 7.

ALTERNATIVE 1

Recreational Opportunity

General access to recreational areas would be minimally affected by project development for those areas contiguous to project operations. Access would be affected temporarily by delays and increased traffic during the construction phase of the project. Both foot and vehicle access would be restricted in the immediate vicinity of project facilities. The public would be restricted from the permitted mine area for safety and security reasons once construction has begun. Undisturbed areas that are not fenced would continue to be open to the public. Access to the Poorman Creek and Cable Creek drainages would be coordinated with the KNF, and project activities would not restrict access to these drainages. Access to Ramsey Creek drainage would be restricted by a gate at the plant site boundary. Access to public lands on Libby Creek would be largely unaffected by the project. The existing Libby Creek Road would remain in place, and access to the portal and disturbed areas would be restricted by gates and fences. Noranda would instruct employees that areas restricted to public access for hunting and other recreational activities would also be restricted for off-duty employee use. Overall, project development would alter the travel patterns and access routes to adjacent areas for some individuals.

Population growth associated with the project would slightly increase the demand for recreation. While there is an abundance of regional recreational opportunities, environmental effects of project development and increased demand would reduce the quality of current recreational opportunities in some areas. The view of project facilities and increased traffic associated with project development might diminish the traveling and viewing experience for some individuals.

As part of the grizzly bear mitigation plan, Noranda has proposed that the KNF implement year-round closure of three National Forest System roads (10.9 miles) and seasonal closure of four National Forest System roads (20.1 miles). Year-round closures would occur on the Upper Bear Creek Road (#4784), the Cable-Poorman Road (#6214), the Ramsey-Libby Road (#6210), and the Upper West

Fisher Road (#6746). Seasonal closures would occur on the Upper Miller Creek Road (#4724, the South Fork of Miller Creek Road (#4726) at the junction of the 385 Road, the Midas Creek Road (#4778), and the lower Granite Road (#4791) at its junction with Road #4792.

These closures would reduce the recreational opportunity for travel and viewing, the predominant recreational use on the KNF. Similar motorized recreation opportunities in other drainages on the east side of the Cabinet Mountains that would offer similar scenic attributes do not exist.

Recreational Use

The project would displace some current recreational users of the project area. People seeking solitude on trails along Libby Creek, Ramsey Creek and Poorman Creek probably would substantially reduce their use. An estimated 75 people use these trails in the summer; the trails are used in the winter for skiing and snowmobiling. Although similar recreational opportunity offered in these drainages would be available in other drainages on the east side of the Cabinet Mountains, each affected drainage may have attributes which are not duplicated elsewhere in the area.

Because of their proximity to the project area, recreation facilities at Howard Lake and the Libby Creek Recreation Gold Panning Area would likely experience substantially increased use. The increased population and awareness by Noranda employees of the campground would increase the number of days that the campground is full. Since the campground is frequently full during the summer, the impact is likely to be significant.

Howard Lake Campground and the Libby Creek Recreation Gold Planning Area would be affected by the increased direct and indirect population. The setting for Howard Lake Campground would be affected where the proposed transmission line passes the lake approximately one quarter of a mile away. Impacts would be long term and moderate (see Visual Resources section). The Recreation Gold Panning Area would be directly crossed by the proposed line, creating a visual intrusion for recreational users at this site. This impact would be long term.

Some dispersed recreation use might occur at the proposed substation site at Sedlak Park, though activities and use levels are unknown. Recreational users of this site would probably be displaced to nearby KNF lands during and following substation construction.

Travel and viewing is the primary recreational use in the Libby District. Noranda would widen the proposed access road to accommodate increased traffic. Although the road would be capable of handling safely a larger amount of traffic, some current users may find the increased traffic decreases their traveling and viewing pleasure. Other users may find that the safety of a double lane road enhances their viewing experience.

The structures, access roads, and right-of-way associated with the transmission line would visually intrude on recreation settings, whether they are developed or dispersed. This decline in the scenic quality can adversely affect recreation visitors, especially in settings where concern for natural beauty is high. The transmission line and access roads would conflict with visitor expectations for undeveloped landscapes, even if the actual visual impact is small. Access roads associated with transmission line construction can open new areas for recreation, benefitting recreational users who desire to use them and adversely affecting recreational users who desire non-roaded settings.

Increased traffic levels, dust, and noise would occur on area roads during transmission line construction. The sights and sounds of road and line construction, and right-of-way clearing would detract from the natural setting. Those recreational users seeking solitude would be displaced from areas undergoing construction. This would be a short-term and localized impact.

The main impact to recreation settings would be the visual intrusion of the transmission line. These impacts are discussed in the Visual Resources section.

Cabinet Mountains Wilderness

The Wilderness Act directs the Forest Service to protect the natural character of wilderness and to provide for recreational, scenic, scientific, educational, cultural, and historical uses of wilderness areas. Based on the Wilderness Act's definition of wilderness, the Forest Service describes four requisite attributes of wilderness as—

- natural integrity;
- apparent naturalness;
- outstanding opportunities for solitude; and
- opportunities for primitive recreation.

These attributes are applied to the conditions inside the boundaries of the wilderness. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not require that adverse affects associated with those activities be mitigated. Buffer zones for adverse effects are considered to be inside and not outside the wilderness boundary.

Natural integrity is the extent to which long-term ecological processes are intact and operating. This attribute describes how human influences alter natural processes by comparing an area's condition to its probable state after human contact.

Apparent naturalness is closely related to natural integrity. Both qualities may be altered by the same activities. Apparent naturalness focuses on how the activities are perceived by the general public. Impacts are seen, heard or smelled.

Solitude is isolation from sights, sounds, and the presence of others. The developments and evidence of man do not appear. Features that contribute to solitude include size of area and distance from perimeter to center. Vegetation and topographic screening are also related to solitude.

Primitive recreation provides opportunities for isolation from the evidence of man. Visitors may enjoy a high degree of challenge and risk, and use of outdoor skills.

As discussed more fully in the Visual Resources section, the Montanore Project would affect the existing wilderness environment from three key viewpoints within the Cabinet Mountains Wilderness—Elephant Peak, Bald Eagle Peak, and Snowshoe Peak. Visitors to Elephant Peak would have a direct view of the plant facilities. The visitors to Bald Eagle Peak would have a distant view of the percolation ponds. Visitors to Snowshoe Peak would have a distant view of the tailings disposal impoundment.

Each of these wilderness peak destinations is currently used by an estimated one to four hiking parties per month over the June to September period (C. Howard, Resource Assistant, pers. comm., w/ M. Stanwood, January 24, 1990). At four persons per party and three parties per month per viewpoint, the wilderness experience of approximately 144 persons could be adversely affected by project development.

Noise from project facilities would be audible at certain wilderness locations near the facilities. The zone of audibility within the wilderness would not be extensive, and actual recreational use within this zone (relative to total recreational use within the wilderness) would be of little significance. Noise impacts would be greater during construction, but would be temporary, and would cease at project's completion.

The wilderness experience is highly personal and individual, so the effects would differ among individuals. It is likely that project development would have significant adverse impacts on the wilderness experience of some individuals at selected locations within the wilderness. Although some evidence of human activity already exists within the wilderness (e.g., trails, litter), all four requisite attributes of wilderness experience would be

diminished during the life of the project at some specific locations within the wilderness. The effects would occur during the project operations and diminish as activity decreases and revegetation increases.

Roadless Areas

The area surrounding the proposed plant site and portions of the access road to the plant are within the boundaries of the 54,800 acre Cabinet Face East Roadless Area described in the KNF Forest Plan FEIS (Kootenai National Forest, 1987, Appendix C). The roadless area is located along the eastern edge of the Cabinet Mountain Wilderness, extending about 36 miles south from Libby. The average width is approximately 2 miles. The proposed activities would directly impact about 25 acres of the roadless area.

Natural integrity and apparent naturalness. The roadless area boundary excludes most improvements and all roads, leaving the inventoried area very natural appearing. Alternative 1 would not change the overall appearance of the roadless area. On-site changes in apparent naturalness would occur, but the impacts would not extend beyond the access road right-of-way or beyond the physical bounds of the plant site.

Opportunities for solitude. The northern half of the roadless area offers good opportunities for solitude because of forested slopes and lack of roads. The southern half offers moderate opportunities for solitude because of the existing low standard roads that penetrate within the steep canyons. The proposed facilities in Ramsey Creek would further reduce a person's opportunity for solitude in the immediate watershed area because of the sights and sounds that would be generated by the mine development. Some of the proposed road closures included in the grizzly bear mitigation plan, would improve opportunities for solitude within the roadless area. Opportunities for solitude in the Cabinet Face East Roadless Area, as a whole, would not be significantly affected.

Primitive recreation opportunities and other features. Primitive recreation opportunities available in the Cabinet Face Roadless Area include hiking, hunting, stream fishing, horseback riding and snowmobiling on the existing roads (outside the inventoried roadless area). Challenging experiences are available such as rock climbing on the steep rock faces and cross-country ski touring, primarily in the south half of the roadless area.

Alternative 1 would negate some opportunities in the Ramsey Creek drainage for the life of the project. Primitive recreation opportunities would not be affected in the balance of the roadless area.

Wilderness manageability and boundaries. This long, linear roadless area has a boundary which is easily defined in some places and less so in others. Throughout its entire length, the boundary would produce a net gain in the manageability of the wilderness through increased size relative to its border.

The least desirable parts of the inventoried roadless boundary are the narrow corridors drawn to exclude the roads in certain drainages including Ramsey Creek. In its present configuration, this boundary would allow nonconforming uses well within the topographic confines of a potential wilderness. Under Alternative 1, portions of the plant site and portal, access road and transmission line may encroach on proposed boundary and would further complicate establishment of a wilderness boundary in Ramsey Creek.

However, when comparing the estimated disturbed acreage of the plant site and associated facilities with the total acreage of the Cabinet Face East roadless area, the impacts on the roadless area characteristics would negligible.

ALTERNATIVE 2

Noranda would implement several measures to mitigate recreational impacts and increase recreational

opportunity. If the Bear Creek and Libby Creek roads are snowplowed in the winter, Noranda would also snowplow turnouts. This would provide increased safety, access and recreational opportunity.

Noranda would reconstruct portions of the Great Northern Mountain trail which originates near Howard Lake. This would partially minimize the loss of the Ramsey Creek road 4781, which has been used as a trail since 1981.

Noranda would construct an overflow parking facility on the Leigh Lake Road 3/4 mile downstream of the existing trailhead. This would minimize parking congestion and increase recreational opportunity.

Noranda would construct two additional day use sites at Howard Lake Campground. This would minimize day use crowding impacts as a result of potential increased use associated with mine development.

At the Libby Creek Recreation Gold Panning Area, Noranda would install three additional fire pits; construct 1/2 mile of new walking access in several locations; and install a precast concrete vault toilet. These measures would reduce the impacts of the anticipated increased use of the area.

Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternative 1.

ALTERNATIVE 3

Alternative 2 would reduce the visual impacts associated with the percolations ponds. The site would not be visible from Bald Eagle Peak and Elephant Peak within the Cabinet Mountains Wilderness. The impact to recreational users of these locations would be reduced. Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternatives 1 and 2.

ALTERNATIVE 4

Proposed mitigation for visual concerns would reduce the visual intrusion of the transmission line for recreational users, though the right-of-way clearing, structures, and access roads would still be visible. Proposed access roads would continue to make previous non-roaded areas in upper Miller Creek more accessible to hunters and other recreational users.

Line location near Howard Lake would stay the same as in Alternative 1, but would be adjusted at the Libby Creek Recreation Gold Panning Area to avoid crossing the developed area. Depending on final centerline location, this adjustment could result in lower impacts to recreational users who use this area (see Visual Resources section).

ALTERNATIVE 5

This alternative would affect the setting of the Miller Creek drainage, creating a visual intrusion for some recreational users (see Visual Resources section). It would avoid the Howard Lake area and avoid crossing the developed area at the Libby Creek Recreation Gold Panning Area. A two-mile segment of this alternative straddling the Miller Creek-Midas Creek divide would open a currently non-roaded area to new access.

Impacts in the Ramsey Creek drainage are the same as those for Alternative 1.

ALTERNATIVE 6

This alternative would affect the setting of Swamp and Midas Creek drainages, creating a visual intrusion for some recreational users (see Visual Resources section). Both of these drainages are characterized by low levels of use.

This alternative would avoid the Howard Lake area and avoid crossing the developed area at the Libby Creek Recreation Gold Panning Area. Impacts in the Ramsey Creek drainage are the same as those for

Alternative 1. Changes in the setting for recreation sites and dispersed recreation activities resulting from construction of the transmission line are discussed in the Visual Resources section.

Transmission line construction also would result in increased traffic levels, dust, and noise on area roads. This would be a short-term impact, diminishing the recreation experience for some users.

ALTERNATIVE 7

Recreational opportunities and the wilderness experience would remain essentially as they are now.

CUMULATIVE IMPACTS

Development of the ASARCO Rock Creek mine would likely have similar effects on recreation and wilderness as those described for development of the Montanore Project. Population increases due to both projects would slightly increase demand for recreational opportunities in the region. Even with this increased demand, there would remain an abundance of outdoor recreational opportunities for residents and visitors alike. The increased traffic and noise from both mining operations would slightly diminish the quality of certain recreational experiences at specific geographic locations.

The Rock Creek development would not be evident from viewpoints identified for the Montanore Project visual analysis. Other viewpoints within the Cabinet Mountains Wilderness, however, would be affected by the Rock Creek Project in ways similar to those described above for Montanore Project development. Wilderness visitors of some locations would also be affected by the proposed timber harvesting. From some areas, wilderness visitors could be cumulatively affected by adverse visual effects from two or more developments rather than just the Montanore Project.

RESOURCE COMMITMENTS

The recreational experiences of some individuals might be considerably affected by the proposed project. The project would be visible from a number of key viewpoints, both in the Cabinet Mountains Wilderness and within the KNF, and, as a result, the travel and viewing quality of the forest might be perceived by some as significantly affected. The cumulative effects of the proposed ASARCO Rock Creek Project, the Montanore Project, and planned timber harvest, when coupled with the existing clearcut areas visible from the Cabinet Mountains Wilderness, might contribute to a loss of wilderness attributes desired by for some individuals.

VISUAL RESOURCES

SUMMARY

The Montanore Project includes five components that would create recognizable visual impacts—the plant site, the percolation ponds and waste rock storage areas, the tailings impoundment, the access roads and the transmission line. Another project component, the Libby Creek adit, is presently under construction in upper Libby Creek. The plant would significantly affect the views from Elephant Peak. The tailings impoundment would affect the view from the Bear Creek Road viewpoint and from two viewpoints on Libby Creek Road. The low view angle of these viewpoints reduces the impact because of the small amount of actual disturbed area seen relative to the size of the impoundment area. The tailings impoundment area would also be fully visible from Horse Mountain Saddle. Two other viewpoints, Snowshoe Peak and Great Northern Mountain, would be affected by the tailings impoundment, but effects are low due to view distance and landforms. The percolation pond

area would be visible from two key viewpoints in the wilderness and fully visible from Horse Mountain Saddle. None of the identified key viewpoints would be significantly affected by the Bear Creek Road improvements.

Under Alternatives 2 and 3, Noranda would develop additional vistas along the Bear Creek and Libby Creek roads and would undertake a roadside tree management program to reduce or mitigate visual impacts. Alternative 3 would reduce the visual impacts associated with the percolations ponds. Short segments of all transmission line alternatives (4, 5, and 6) would be visible from wilderness viewpoints where the cleared right-of-way passes through dense timber. For most wilderness viewpoints, impacts would be low due to the background distance of the transmission line and existing modifications of the landscape.

ALTERNATIVE 1

Noranda and the agencies identified key viewpoints of the project facilities based on proximity to the project area (Figure 4-8). The sensitivity of each key viewpoint was determined on the basis of the number and type of viewers and duration of views. Primary roadways and recreation areas were located on maps and then field-verified to establish viewpoints representing a full range of locations and types. Roadways studied include Bear Creek Road (USFS Rd. 278), Ramsey Creek Road (USFS Rd. 4781) and three viewpoints on Libby Creek Road (USFS Rd. 231). Recreation areas and primary visitor destination points investigated included Howard Lake, Horse Mountain Saddle, Great Northern Mountain, Snowshoe Peak, Bald Eagle Peak and Elephant Peak.

Noranda provided computer visibility maps to determine the visibility of the project components from each identified key viewpoint. The key viewpoint visibility matrix summarizes the distance and viewing angle of project components as expected to be seen from each key viewpoint (Table 4-31).

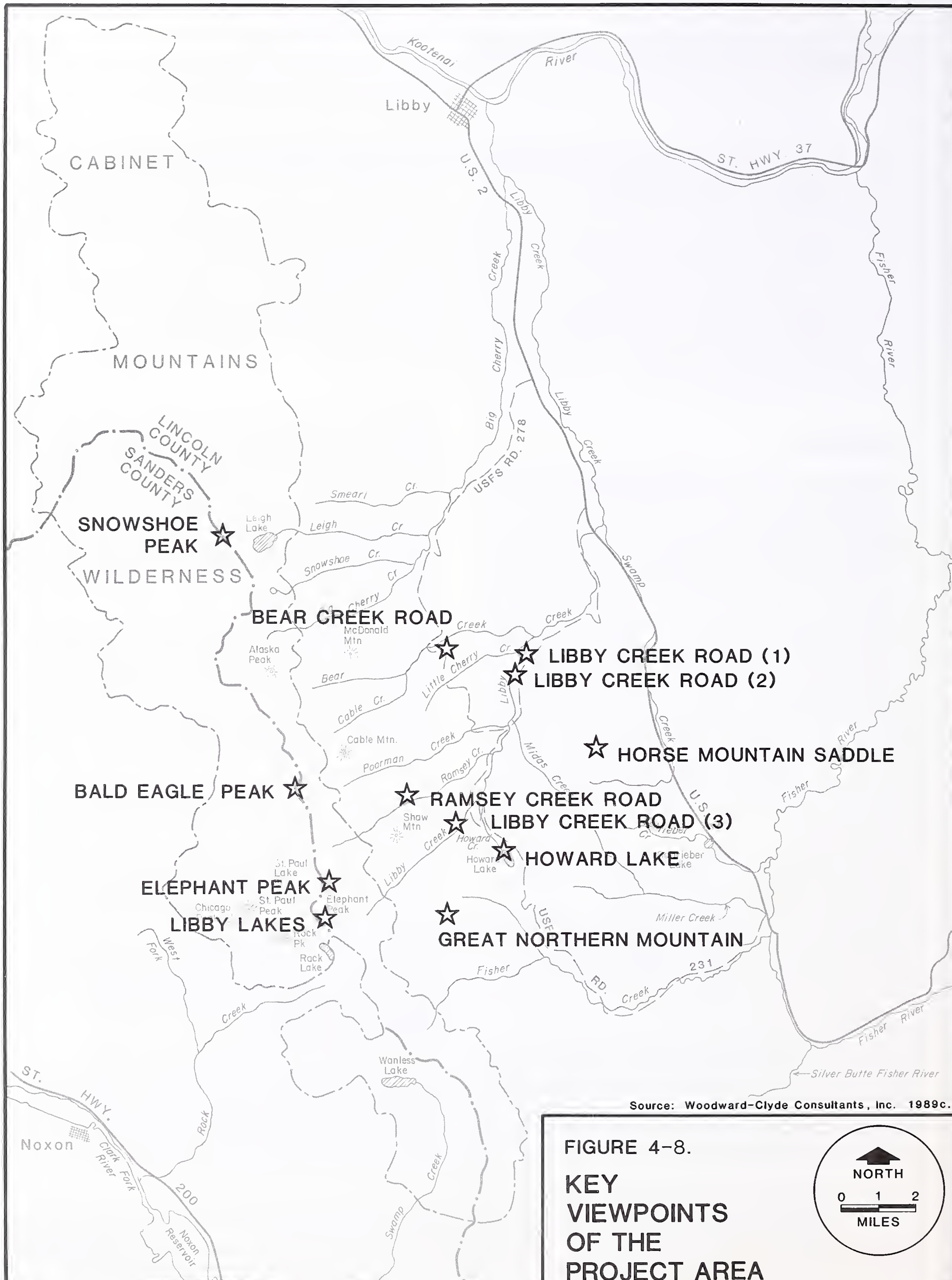
Plant Site

The plant site would be fully visible in the middleground from the Elephant Peak viewpoint and would significantly affect the visual quality from there. Appendix D contains a visual simulation of the view from Elephant Peak. Elephant Peak is within the Cabinet Mountains Wilderness and is a destination point for wilderness users. View quality is very sensitive (Level 1) and view duration is typically long. The effect of the plant on the view is compounded by the long view duration, the sensitivity of the view, the lack of a foreground view and the high view angle.

The Visual Quality Objective (VQO) under KNF's Visual Management System (VMS) for the proposed plant site is Retention. Activities appropriate for a Retention VQO "may only repeat form, line, color and texture which are frequently found in the characteristic landscape." The proposed plant would not meet this objective.

Two additional viewpoints that would be marginally affected by the plant include Horse Mountain Saddle and Ramsey Creek Road. Although the plant site could be seen from Horse Mountain Saddle, the long view distance and the high Visual Absorption Capability (VAC) would reduce the visual impacts. The mill, however, may affect foreground views from Ramsey Creek Road because of facility height, but should be only marginally visible because of the dense vegetation and low view angle obscuring most or all of the proposed mill.

The visual impacts of the plant site would occur throughout the life of the project. Following reforestation (20 to 30 years), the impacts would be significantly reduced. The proposed revegetation



Source: Woodward-Clyde Consultants, Inc. 1989c.

FIGURE 4-8.

KEY VIEWPOINTS OF THE PROJECT AREA

plan would return the site to near its original texture and color. The disruption of the Ramsey Creek valley's form by the cut-and-fill slopes of the plant site would continue to be visible from Elephant Peak for a number of years following operations.

Percolation Ponds

The percolation ponds site would be visible from a number of key viewpoints, including Bald Eagle Peak, Great Northern Mountain and Horse Mountain Saddle. The three affected viewpoints have a high view angle to the percolation ponds. Great Northern Mountain and Bald Eagle Peak are most sensitive because they are popular destinations for hikers and visitors. Horse Mountain Saddle has the lowest visual sensitivity. The visibility of the ponds from these three viewpoints would be reduced by the long viewing distance. Horse Mountain would be about four miles away and Great Northern Mountain and

Table 4-31. Possible views of mine facilities from designated key viewpoints.

Viewpoint	Plant site	Percolation ponds	Tailings impoundment	Bear Creek Road	Viewpoint angle
Cabinet Mountains Wilderness viewpoints					
Snowshoe Peak	∅	∅	❑	❑	H
Bald Eagle Peak	∅	❑	∅	❑	H
Elephant Peak	◆	❑	∅	∅	H
Libby Lakes	∅	∅	∅	∅	H
Other viewpoints					
Bear Creek Road	∅	∅	■†	∅	L
Great Northern Mountain	∅	❑	❑	∅	H
Horse Mountain Saddle	❑	◆	◆	❑	H
Howard Lake	∅	∅	∅	∅	N/A
Libby Creek Road (1)	∅	∅§	■	∅	L
Libby Creek Road (2)	∅	∅§	■	∅	L
Libby Creek Road (3)	∅	∅	∅	∅	L
Ramsey Creek Road	❑†	∅	∅	∅	L

View distance

■ Foreground view (<than 1/2 mi)
◆ Middle ground view (1/2 to 3 mi)
❑ Background view (>than 3 mi)
∅ Not visible

Viewpoint angle

H High—Views would look down on proposed facilities
L Low—Views of proposed facilities are at about eye level

†Extent of visibility uncertain
§Visibility maps prepared by Noranda indicate the facility area would be visible for the particular viewpoint; dense vegetation and low view angle would likely obscure views of proposed facilities

Source: Woodward-Clyde Consultants, Inc. 1989c.

Bald Eagle Peak are about eight to ten miles away. With the exception of Horse Mountain Saddle, the ponds are in a background view and may even be obscured by dense vegetation and landforms. Though the view from Horse Mountain Saddle would be affected to a larger extent, it has the lowest sensitivity level. The duration of the view could be a factor from Bald Eagle Peak and Great Northern Mountain, but it should be mitigated due to the panoramic quality of the views from these points.

The VAC for the percolation pond area is moderately high, reflecting a good ability to absorb visual change. The VQO, classified as retention, calls for management activities which are not visually evident. The clear cutting of trees for the percolation ponds should be similar to the existing patterns created by timber harvesting in the area and would meet the visual objective.

Two viewpoints along Libby Road, located about four to five miles away at the same relative elevation as the percolation ponds could also be affected by the percolation ponds. Due to the dense growth of trees and the low view angle, neither viewpoint likely would be affected.

Tailings Impoundment

The tailings impoundment, located in the Little Cherry Creek drainage, would be visible from five key viewpoints, (two on Libby Creek Road, and one each on Horse Mountain Saddle, Great Northern Mountain, and Snowshoe Peak). Appendix D contains a visual simulation of the view from Libby Creek Road. Because of a high view angle, the view from Horse Mountain Saddle would incur the greatest impact by the tailings impoundment. From that viewpoint, the viewer would have a direct, uninterrupted, middleground view of the disturbance. Although the viewpoint has the lowest visual sensitivity, the potential for long view duration and quality views exist because of the viewpoint's location.

Of the five key viewpoints affected, two are destination peaks, Great Northern Mountain and Snowshoe Peak, the latter located in the Cabinet Mountains Wilderness. Both viewpoints have Level 1 sensitivity (highest sensitivity). From these viewpoints, however, the impoundment would be located in the background (more than 10 miles away) and may be obscured by landforms.

Two viewpoints along Libby Creek Road (1 and 2) are relatively close together and would be significantly affected by the form and mass of the proposed impoundment dam. Libby Creek Road has a Level 2 (moderate) sensitivity. The view from Libby Creek Road would be near the same elevation as the tailings impoundment, eliminating the possibility of seeing the total impoundment site. The only visible portion of the impoundment would be the dam. As a result of timber harvesting adjacent to the road, numerous small openings would provide a view of the impoundment dam. View duration would be long due to the number of openings and the viewer's attention being focused toward the Cabinet Range. Bear Creek Road also has a key viewpoint located near the impoundment. As the tailings impoundment increases in size, it may become more noticeable from this viewpoint.

The VAC of the proposed impoundment area is moderate, reflecting a moderate ability to absorb visual change. Because of the proposed impoundment size, very little can be done to reduce the visual impact, particularly for high view angles. The visual quality objective is partial retention. Activities or modifications as described by the VMS "may repeat form, line, color or texture common to the characteristic landscape, but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape." The impoundment would not remain subordinate to the characteristic landscape, and would not meet the visual objective of partial retention.

The visual impacts of the impoundment would occur throughout the life of the project. Following reclamation, the impacts would be significantly reduced. The proposed revegetation plan would

return the site to near its original texture and color. The impoundment would interrupt the present form of the Little Cherry Creek drainage.

Bear Creek Road Improvements

The Bear Creek Road improvements would be visible from three key viewpoints (Snowshoe Peak, Horse Mountain Saddle, and Bald Eagle Peak). Because of a high view angle, the potential to see these road improvements is possible. However, from these viewpoints, Bear Creek Road is located in the background view (more than 10 miles away) and may be obscured by dense vegetation and landforms. The Bear Creek Road improvement would not significantly affect the visual quality from the identified key viewpoints. Proposed reclamation following road improvements would decrease the visual effects from other viewpoints.

Transmission Line Corridor

Alternative 1 would result in 1.7 miles of high impact, 5.3 miles of moderate impact, 6.8 miles of low impact, and 2.5 miles of very low impact (Table 4-32; Figure 4-9). Of the four transmission line route alternatives, it would result in the most visual impact.

High and moderate visual impacts would be common along U.S. 2 between the proposed substation and the point where the line would enter the Miller Creek drainage. Proximity to residences and high levels of visibility from the highway contribute to these impact levels.

Visual impacts in the Miller Creek drainage would be low. The Miller Creek drainage is a moderately used, dispersed recreation area having lower viewer sensitivity than the U.S. 2 corridor or the Howard Lake and Libby Creek areas. Impacts would be low for the portion of the line closely paralleling USFS Rd. 4724. Portions of this corridor would be visible from the road as the road ascends the south side of the drainage. Impacts would be low in upper Miller Creek where the line and associated right-of-way clearing would be screened from most viewpoints within the drainage.

This alternative would result in moderate visual impact between Libby Divide Trail and Ramsey Creek. This area is more heavily used for recreation than the Miller Creek area. It includes two recreation sites—Howard Lake Campground and the Libby Creek Recreation Gold Panning Area—and provides access to four trail heads.

The visibility of the proposed transmission line from wilderness viewpoints contributes to higher impacts. Steep hillsides covered with dense forest growth have a moderate-to-low capability to screen the transmission line.

Table 4-32. Visual impacts of the transmission line routes.

Visual impact category	Alternative 1	Alternative 4	Alternative 5	Alternative 6
	miles			
High	1.7	1.5	1.5	1.7
Moderate	5.3	5.2	4.7	4.6
Low	6.8	7.2	7.9	4.3
Very low	2.5	2.5	1.8	6.6
Total	16.3	16.4	15.4	17.2

Source: Department of Natural Resources and Conservation. 1990.

Moderate visual impacts would result where this alternative crosses the Libby Divide and Miller Creek trails and passes by Howard Lake. Visibility of the transmission line from the trails, Howard Lake, and USFS Road 231 contributes to the visual impact.

Visual impact near Howard Creek would be low when topography is relatively flat, and the area landscape is better able to absorb impacts of the new line. High visual impacts would occur where this route crosses the developed area at the Libby Creek Recreation Gold Panning Area.

The portion of this alternative which follows Ramsey Creek to the plant site would have low visual impact. The proposed transmission line would be located next to the access road and tailings pipelines through this narrow canyon. Visibility would be limited to the wilderness viewpoint near Elephant Peak area at the head of the drainage. The transmission line would generally meet the visual quality objectives of Partial Retention and Modification, but would have difficulty meeting a Retention objective.

Substation, Microwave Repeater Station, and Receptor

Visual impacts from the microwave repeater station near Barren Peak would depend on final site location. Construction of this facility would be by helicopter, minimizing ground disturbance to an area about 100 feet by 100 feet. Road construction to this facility would not be permitted, eliminating any visual impact caused by visibility of cut and fill slopes. Depending on final site location, the station could be visible from some locations in the surrounding valleys. Painting or other treatment of the station to produce a dark flat color would help it blend in with the surrounding landscape and vegetation. The 150-foot tall receptor at the substation site would be visible from the Manicke Community Church. Impacts of the microwave repeater station and receptor would be the same for all action alternatives.

The proposed substation at Sedlak Park would be visible to highway travelers, though views would be of very short duration. Topography and vegetation at the proposed substation site screen long distance views from U.S. 2, providing only limited views of short duration as highway travelers pass by. The substation also would be visible from the Manicke Community Church directly across U.S. 2 from the proposed site.

ALTERNATIVE 2

Noranda would implement a number of modifications to reduce visual impacts. Earth-tone paints would be used at the facilities, reducing the visual contrast with the existing vegetation. Waste rock piles and percolation ponds would be located to minimize impacts to visual resources.

Noranda would develop three additional viewpoints along the Bear Creek and Libby Creek roads with views focusing on the Cabinet Mountain range. This would help negate contrasting views associated with the development and operation of the tailings impoundment in Little Cherry Creek.

Noranda would undertake a roadside tree management program to obscure any project facilities along primary travel routes. The tailings impoundment would be visible from some viewpoints along the Libby Creek and Bear Creek roads.

Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternative 1.

ALTERNATIVE 3

Alternative 3 would reduce the visual impacts associated with the percolations ponds. The site would not be visible from the Bald Eagle Peak and Elephant Peak viewpoints within the Cabinet Mountains Wilderness. Other effects, including adverse visual impacts from other viewpoints, would be as described for Alternative 1 and 2.

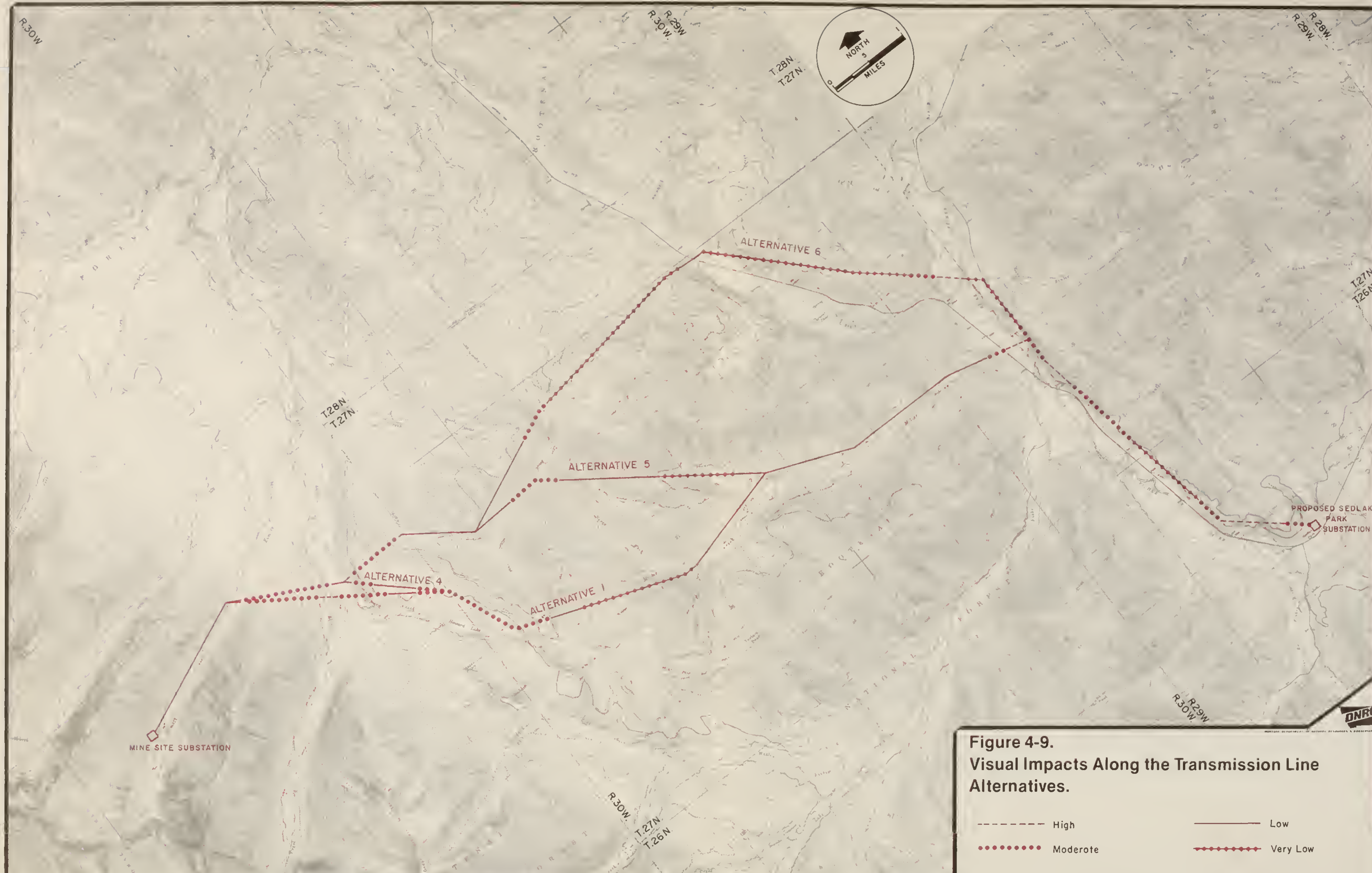


Figure 4-9.
Visual Impacts Along the Transmission Line Alternatives.

High
Moderote
Low
Very Low

ALTERNATIVE 4

Visual impacts for Alternative 4 would be similar to those of Alternative 1. Adjustments to proposed line route, at the Libby Creek Recreation Gold Panning Area to cross this site at a different location and at the U.S. 2 crossing to avoid close proximity to residences, would decrease visual impact to moderate levels.

In viewer-sensitive locations identified by the agencies (U.S. 2/Fisher River corridor and Libby Creek area), taller than standard poles may be required to reduce clearing needed for safe operation of the line. Recommendations for taller poles would be made on a case-by-case basis by weighing the visual or other environmental advantages against the costs of taller poles.

Helicopter use rather than a crawler tractor during initial stringing operations would decrease right-of-way clearing and grading requirements along approximately half of the line, though clearing for conductors and structures would still occur. This measure would reduce visual impact levels moderately.

The monopole steel towers used for the line would be treated or painted a darker non-reflective color.

Non-reflective static wire and electrical conductors would be used for the entire length of the line. A non-ceramic insulator is recommended for the entire length of the line. If ceramic insulators are used, the color should be brown. Clear glass insulators would not be used.

ALTERNATIVE 5

Alternative 5 would have 1.5 miles of high visual impact, 4.7 miles of moderate impact, 7.9 miles of low impact, and 1.8 miles of very low impact. It would rank second along the three transmission line alternatives in visual impact (see Table 4-32, Figure 4-9).

This alternative has the same location and same impacts as the proposed project along U.S. 2 and in lower Miller Creek. Where this alternative diverges from the proposed line, impacts would be minimal as visibility of the line decreases to very low levels. The line would become more visible as it approaches the North Fork Miller Trail and Libby Divide Trail. Impact levels would increase to moderate as the line approaches the Libby Divide Trail at the ridgeline. Access road construction and location of structures would make this alternative highly visible near the ridgeline.

Dispersed recreation use is low in the Midas Creek drainage. Within this area, impacts would be moderate near the Libby Divide Trail. Impact levels then decrease to low as visibility is limited to viewpoints in the drainage and views from Horse Mountain about 1.5 miles to the north.

Impacts would be moderate where this alternative leaves the Midas Creek drainage and descends toward Libby Creek. The line would cross areas used more heavily for recreation when compared to the Midas Creek drainage. Right-of-way clearing would make the line's location visible from wilderness viewpoints. Impacts would be low across the Libby Creek bottom, then increase to moderate as the line crosses a spur ridge of the Cabinet Mountains between Libby and Ramsey creeks.

Impacts would again be low along portions of the route common to Alternative 1 in Ramsey Creek.

ALTERNATIVE 6

Alternative 6 would result in 1.7 miles of high visual impact, 4.6 miles of moderate impact, 4.3 miles of low impact, and 6.6 miles of very low impact. It is the lowest in visual impact of all transmission line alternatives.

This alternative is identical to the proposed project along the U.S. 2 corridor and would have the same visual impacts in this area. This alternative parallels

the highway for approximately four miles beyond the point where the proposed location bends to the west. Impacts would be very low for most of this length because the line would be screened from view by topography and riparian vegetation. Visual impact would increase to moderate and high levels at the Fisher River crossing due to the close proximity to residences. The line would be visible to highway travelers where it crosses U.S. 2, but visual impacts would be low.

Impact would be very low in the Swamp Creek drainage due to low levels of recreation use and the existing landscape character. Extensive timber harvesting in this area would decrease right-of-way clearing requirements but increase structure visibility.

Like Alternative 5, this alternative would have moderate impact where it crosses the Libby Divide Trail. Impact would be low in the Midas Creek drainage.

This alternative is identical to Alternative 5 from the head of Midas Creek to the proposed plant site.

ALTERNATIVE 7

Not building the proposed mine facilities and transmission line would maintain the existing visual character of the area. The landscape would continue to undergo modifications associated with timber harvesting, road building, and other activities.

CUMULATIVE IMPACTS

Timber harvesting has affected the visual quality of the project area. Nearly 25 percent of the area has been subjected to timber harvesting over the past 20 years. Additional timber harvesting is proposed. Although views from primary travel routes are less affected, views in the Cabinet Mountains have been significantly affected by timber harvesting activities. During the life of the project, the visibility of surface facilities as previously described would contribute to the developed nature of the landscape. Eventual reclamation of the Montanore Project would minimize long-term cumulative impacts to the visual resource, as would reforestation of clear-cut areas.

The ASARCO Rock Creek mine would not create any direct cumulative visual impacts to the study area. No key viewpoints identified for the Montanore Project would be within view of the ASARCO mine. Some indirect impacts may occur. Some viewpoints in the Cabinet Mountains Wilderness would be affected by the ASARCO mine. As visitors move between points in view of the two mines, their overall visual experience might be diminished.

RESOURCE COMMITMENTS

The project would be visible from a number of key viewpoints, both in the Cabinet Mountains Wilderness and within KNF. The visual impact of the tailings impoundment, transmission line, and the plant would significantly affect some forest users. Although the proposed revegetation plan would, when fully successful, serve to decrease the visual effects of many of the proposed mine components, the tailings impoundment site would always remain incongruent with the surrounding landscape.

TRANSPORTATION

SUMMARY

Under Alternative 1, employee and mining vehicles would significantly increase traffic levels on the Bear Creek Road. Congestion on U.S. 2 and USFS roads 278, 2317 and 4781 would be minimal if planned improvements by the Montana Department of Highways and Noranda are completed. Traffic from the proposed project would not significantly affect the load-carrying capacity of the roadway surfaces or structures. Because the proposed Bear Creek access road width is narrow, disabled trucks might present a safety problem. Depending on peak hour traffic volumes, the intersection of U.S. 2 and the Bear Creek road could be congested. A safety hazard could exist for the vehicles on the Bear Creek Road turning north onto U.S. 2 towards Libby.

Through a proposed mandatory busing program, Alternatives 2 and 3 would result in significantly lower vehicle trips per day on roads used for mine access. Planned Montana Department of Highways improvements to U.S. 2 would not be needed until the year 2009 to achieve an acceptable level of service. Additionally, any congestion at the intersection of U.S. 2 and Bear Creek Road resulting from the project would be reduced.

Impacts associated with Alternatives 4 and 5 would not be different from those associated with Alternative 1. With Alternative 6, short-term construction impacts on Highway 2 traffic would be similar to Alternative 1, although these effects would occur in a different location. Under the no action alternative (Alternative 7), increased traffic levels and accidents would not occur, and planned improvements to U.S. 2 would not be necessary.

ALTERNATIVE 1

Traffic Congestion

Traffic impact assessment requires selecting a desired level of service (see Chapter 6, Methods). Since the proposed project would be in a rural environment, level of service C is used as a minimum level of service considered acceptable. Level of service C results in the average speed being five miles per hour less than the posted speed; oncoming traffic also impedes passing. Impacts are considered unacceptable if increased project traffic would result in a level of service below level C.

U.S. 2. Where it exists as a two-lane rural highway, U.S. 2 is capable of carrying about 610 vehicles per hour and maintaining a level of service C. The daily traffic flow on the two-lane portion of U.S. 2 was 3,149 vehicles in 1988, and traffic is projected to increase to 3,880 vehicles in the year 2008, without the project-related traffic. These volumes translate into 470 vehicles per hour in 1988 and 500 in 2008 during the peak hour. These volumes would allow U.S. 2 to continue operating at a level of service C without the proposed project traffic.

When estimated traffic levels resulting from the Montanore Project are added to the baseline condition, 730 vehicle per hour would occur in the peak period in 2008. The 2008 estimated peak hour volumes would exceed the level of service C. It is estimated that U.S. 2 would reach its level of service C in about 1995. These calculations are based on the existing cross-section of U.S. 2. The Montana

Department of Highways is in the process of improving the highway by adding shoulders. Following completion of improvements, the highway would operate at an acceptable level of service.

Transmission line construction is expected to cause little additional traffic impact on U.S. 2. Some minor, short-term increases in construction traffic can be expected along U.S. 2 south to the Sedlak Park substation site. Increases in traffic and minor disturbances of traffic flows might result as construction traffic leaves U.S. 2 to other roads during construction and when construction across the highway occurs. Because of construction traffic, minor inconvenience and delays can be expected for logging and recreational traffic using forest service and Champion roads in construction areas. Any construction activity that would affect highway traffic or traffic along the Miller Creek road would require proper signing and other measures as required by the Montana Department of Highways and the KNF (Appendix F).

Access roads. Noranda would upgrade the Bear Creek Road from U.S. 2 to the Bear Creek Bridge and relocate and reconstruct the Bear Creek Road from the bridge to the proposed plant site. During the 1.5-year construction period, the Libby Creek Road would likely be used for construction traffic. Traffic volumes on the Bear Creek Road would increase 530 percent, from 135 vehicles per day in 1990 to 850 vehicles per day in 2008. Improvements proposed by Noranda would allow the Bear Creek to operate at an acceptable level of service during the life of the project. Similar increases would occur on the Libby Creek Road during the construction phase.

U.S. 2 and access roads intersections. Some increased congestion may occur at the U.S. 2 and Bear Creek Road intersection and the Libby Creek Road and U.S. 2 during the construction phase. The amount of congestion would depend on the amount of traffic occurring at peak hour level.

The ore concentrate trucks would use a private haul road. No information is available on the private haul road, so the adequacy of the road's capacity could not be assessed.

Road closures. Noranda has proposed several road closures as part of the grizzly bear mitigation plan. These road are used primarily by recreational users and the proposed closures would not affect traffic patterns in the area.

Safety

Additional traffic on U.S. 2 and the Bear Creek Road would result in additional accidents. About 14 accidents per year occur on U.S. 2 between the Bear Creek Road and Libby. Almost all of these accidents are severe. The traffic from the proposed project would result in an additional 2.5 accidents per year, or an 18 percent increase over the current condition.

A safety hazard would exist for vehicles turning left from the Bear Creek Road onto U.S. 2 toward Libby. Vehicles making this turn would be crossing the south-bound lane of U.S. 2 and merging into the north-bound lane of U.S. 2 which has a posted speed of 55 mph. A similar hazard would exist during the construction phase at the Libby Creek Road and U.S. 2 intersection.

No information is available for past accident rates on the proposed access road. Given the projected traffic increase on the proposed access road, the number of accidents would be expected to increase by a factor of about five. Since the number of accidents now occurring on this road is low, this would not be a significant impact. Due to the low speed limit on these roads, most of these accidents should not be severe.

Because of the narrowness of the Bear Creek and Libby Creek roads, a large disabled truck would create a hazard. This hazard could occur in portions of the roads where sight distance would not be adequate to permit passing vehicles to see on-coming vehicles.

Load Carrying Capacity

The proposed project would not significantly affect the carrying capacity or surface condition of U.S. 2. All structures on U.S. 2 and the Bear Creek Road are structurally rated to carry the proposed loads. Noranda has said that overweight (greater than 80,000 pounds) vehicles would not be used except to transport very large equipment. Such loads would be subject to review and permitting by the KNF and the Montana Department of Highways.

ALTERNATIVE 2

Noranda would implement a mandatory busing program. This alternative assumes that about 50 percent of the employees would use a mass transit system and the remainder would participate in an increased level of ridesharing (50 percent increase over the base condition). This alternative would result in 169 fewer vehicle trips per day, 75 for the day shift, 47 for the swing shift, and 47 for the graveyard shift.

The improvements planned by the Montana Department of Highways would not be required to achieve an acceptable level of service on U.S. 2 through the year 2008. If the improvements are made by the Montana Department of Highways, the level of service would be above the desired level C for a rural environment. Congestion at the intersection of U.S. 2 and the Bear Creek Road would be reduced, allowing the intersection to operate at an acceptable level of service. Fewer accidents would occur on the U.S. 2 and the Bear Creek Road.

This measure, however, would adversely affect the load carrying capacity of U.S. 2 as a result of the bus traffic. This impact would not be significant.

Noranda would restrict ore concentrate trucks from the access road during shift change periods when a large number employees would be traveling the access road. This would decrease the accident rate on the Bear Creek Road and U.S. 2 and decrease congestion at the Bear Creek Road and U.S. 2 intersection.

Noranda would equip all concentrate trucks with radios to provide communication in the event of a breakdown. Warning signs for oncoming traffic would be posted near any disabled truck. This measure would help reduce the safety hazard.

ALTERNATIVE 3

The transportation impacts of this alternative are not different from the impacts of Alternative 2.

ALTERNATIVES 4 AND 5

Selection of Alternatives 4 or 5 would not affect the overall transportation impacts described under Alternative 1.

ALTERNATIVE 6

Selection of Alternative 6 would move the points of construction access and the crossing of U.S. 2. Construction traffic would leave U.S. 2 at the Schrieber Creek and Coyote Creek roads. Short-term construction impacts on highway traffic would be similar to those under Alternative 1, with the difference being a change in location. Minor inconveniences and delays might occur for logging and recreational traffic using National Forest System or Champion roads in construction areas.

ALTERNATIVE 7

Increased traffic levels and accidents would not occur. Planned improvements to U.S. 2 by the Montana Department of Highways would not be necessary.

CUMULATIVE IMPACTS

Traffic from the proposed Rock Creek Mine would not affect any of the transportation network affected by the proposed Montanore Project. Only a small increase in Lincoln County population is expected from the proposed Rock Creek Project.

Consequently, no cumulative transportation impacts of these two projects would be anticipated.

Traffic associated with timber harvesting would not reduce the level of service on the access road, U.S. 2, or the Bear Creek Road/U.S. 2 intersection. Logging traffic would cause an insignificant increase in wear on U.S. 2.

RESOURCE COMMITMENTS

There are no irreversible or irretrievable commitments of transportation resources. Increased traffic associated with the project would cease after project completion.

SOCIOECONOMICS

SUMMARY

Under base case Alternative 1 assumptions, population migration into the study area would peak at about 411 in 1993. This would be an increase of slightly over two percent above the 1988 Lincoln County population level. The long-term population increase would be an estimated 320 people from 1994 through 2010. Most of these would live in Libby and in rural Lincoln County near Libby. The project would generate an estimated $13.82 million in annual direct and indirect income during full-scale operations.

The larger population would increase the need for community services. The most significant of these expanded needs for services would be increased demands for law enforcement personnel and teachers. The availability of affordable housing would likely be the biggest concern for in-migrating families.

Project development would result in increased revenues and costs to local governments. Montana legislation requires developers to pay for all increased public capital and net operating costs created by new projects.

Under the other action alternatives, projected socioeconomic impacts would be the same as in Alternative 1. Under the no action alternative (Alternative 7), the economic development benefits from 450 jobs during operations, 190 jobs during construction, and $13.82 in annual income associated with long-term operations would not occur.

ALTERNATIVE 1

Project-Related Employment

Primary factors affecting the timing and magnitude of socioeconomic impacts are—

- project hiring schedule;
- the existence of a locally available workforce; and
- the need for additional workers (and their dependents) to migrate to the area.

Noranda has prepared employment estimates for mine construction (including the transmission line construction) and operations phases (Table 4-33). Construction would commence during the third quarter of Year 1 (assumed in this analysis to be 1991) with the hiring of about 150 employees, and would last approximately 2.5 years. Construction employment would peak at 190 employees during the third quarter of Year 2 (1992). By Year 3 (1993),

Table 4-33. Estimated Montanore Project employment—construction and operations.

	Year 1				Year 2				Year 3				Years 4-15
Employment by type	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	All Quarters
Construction employment													
Administrative	0	0	15	10	10	10	15	10	5	5	5	5	0
Technicians	0	0	15	10	10	10	15	10	10	10	5	0	0
Mechanics	0	0	30	70	20	20	50	70	50	50	30	20	0
Equipment operators	0	0	60	60	50	70	80	60	5	5	40	20	0
Laborers	0	0	30	20	20	20	30	20	10	10	10	10	0
Subtotal	0	0	150	170	110	130	190	170	80	80	90	55	0
Operations employment													
Administrative	15	15	15	15	15	15	15	15	20	20	20	20	25
Technicians	15	15	15	15	15	15	15	15	20	20	20	20	25
Mechanics	0	0	0	0	20	20	20	20	90	90	90	90	90
Equipment operators	0	0	0	0	60	60	60	60	220	220	220	220	220
Laborers	0	0	0	0	20	20	20	20	90	90	90	90	90
Subtotal	30	30	30	30	130	130	130	130	440	440	440	440	450
Total project employment	30	30	180	200	240	260	320	300	520	520	530	495	450

Source: Noranda Minerals Corp. 1989a. p. 27-a.

peak construction employment would decline to fewer than 100 employees.

Upon completion of surface plant construction and underground construction and development, the mine/mill complex would be brought up to full production during a 3-to-12-month period. By the beginning of Year 3 (1993), operations employment would reach an estimated 440, ten employees below the full-scale operations workforce of 450 in Year 4 (1994). The peak operations workforce would remain at 450 through the life of the mine, anticipated to be 16 years (through 2010). Total employment (construction and operations) is expected to peak at 530 employees during the third quarter of Year 3 (1993).

It is assumed that 45 percent of the construction workforce would come from existing residents of the Libby/Troy area. This assumption includes the possibility that a non-local construction contractor would be hired and would bring employees from outside the area. A local hiring ratio of 80 percent has been assumed for post-construction operations. This assumption is based on Noranda's hiring experience at other projects, on local hiring ratios for other energy and mineral developments in Montana, Wyoming, and North Dakota, and on the number of available qualified workers as reported by the Montana Job Service Office in Libby (Table 4-34). If conditions were to change, or if Noranda were to recruit non-residents, the hiring ratios for Montanore could change (see the Assumption Sensitivity Analysis discussion later in a following section).

Table 4-35 is an estimate of local hiring ratios by employee type. These figures indicate that Noranda would need to hire 89 percent of the available equipment operators, 18 percent of the available technicians, and about 13 percent of available laborers from the local work force. Other possibilities for local hiring include people currently employed at ASARCO's Troy Mine (see the cumulative impact discussion), and unskilled workers who could be trained.

Table 4-34. Libby Job Service applicants from July, 1988 through June, 1989.

Occupation category	Number of applicants Maximum	Minimum	Average
Equipment operators	250	167	202
Mechanics	61	39	46
Technicians (mine-related)	145	99	112
Laborers	733	510	633
Other	227	141	176

Source: Noranda Minerals Corp. 1989d. p. 61.

Indirect Employment

Growth in basic industry usually creates indirect employment opportunities, primarily in the service and retail trade sectors (e.g., restaurants, retail stores, etc.). It is estimated that each new construction job would lead to 0.3 new indirect employment opportunities, and each new mining job would lead to 0.45 new indirect employment opportunities. These multipliers were chosen on the basis of recent experience in Montana where residents made many major purchases outside the study area. As the area grows and/or becomes more self-sufficient, these indirect employment multipliers might increase (see Assumption Sensitivity Analysis discussion later in a following section).

Table 4-35. Estimated local hiring ratios by employee type.

Phase/Position	Peak employment	Expected local hire Number	Percent
Construction			
Administration	15	3	20
Equipment operators	80	32	40
Mechanics	50	19	38
Technicians	15	5	33
Laborers/other	30	27	90
Total	190	86	45
Operations			
Administration	25	15	60
Equipment operators	220	180	82
Mechanics	90	55	61
Technicians†	25	20	80
Laborers/other	90	90	100
Total	450	360	80

Source: Noranda Minerals Corp. 1989d. p. 60.
†Technicians include lumbermen, welders, firemen, machinists, electricians, warehousemen, carpenters, and janitors.

The multipliers do not reflect any major funds spent by Noranda in the study area. Additional employment could be created if Noranda spends substantial funds on materials and other goods and services within Lincoln County.

This new indirect employment would not happen all at once. It is estimated that 50 percent of the indirect employment resulting from the proposed project would occur in the same year construction and mining employees are hired, with the remaining 50 percent occurring the following year. Peak indirect employment from project developments is estimated to be 210 persons in 1994. It is estimated that 90 percent of indirect employees would be hired from the existing local labor force, yielding a peak indirect worker in-migration of 21 persons in 1994.

Demographic Characteristics of Employees

Some in-migrating employees would have spouses or other dependents. It is assumed that 60 percent of in-migrating construction and indirect employees would be married, and that each in-migrating couple would have an average of 0.83 children (aged 0-18 and living at home). This would mean an overall family size of 2.1 people per in-migrating construction or secondary worker.

It is assumed that 80 percent of in-migrating operations workers would be married, and that each married couple would have an average of 1.625 children. This yields an overall estimated family size of 3.1 people per in-migrating operations worker.

Of the in-migrating children, 45 percent are assumed to be attending school in grades kindergarten through 8th, 19 percent are assumed to be in high school, 35 percent are assumed to not be enrolled in school, and 1 percent is assumed to need special education. These data are based on 1987 Montana school statistics, and on the estimated number of children aged 0-18 living in Montana in 1987.

Income Effects

Based on Noranda's estimated annual payroll, average income per worker would exceed $26,000 per year (Table 4-36). This would be consistent with existing mining wages in the area. Mining would continue to have the highest paying jobs in Lincoln County. Much of this income would be spent within the project area, thereby generating the indirect employment discussed above. The indirect employment associated with the Montanore Project (peaking at 210 people in 1994 with a long-term indirect employment of 200 people) would lead to additional income in the project area. Assuming an average annual income of $9,100 for indirect workers, long-term income due to indirect employment would be $1.82 million. The estimated $13.82 million in long-term annual income attributable to the Montanore Project would be equivalent to 10.9 percent of total 1986 earnings in Lincoln County. The Montanore Project would provide an important source of personal income over the next 20 years.

Table 4-36. Estimated annual payroll.

Project year	Calendar year	Amount (1989 $)
1	1991	2,930,000
2	1992	7,465,000
3	1993	13,760,000
4+	1994	12,000,000

Source: Noranda Minerals Corp. 1989a. V. 1, p. II-27-a.

In addition to direct income effects, Noranda would also make substantial purchases of supplies and services. For example, the Troy Mine makes annual supply purchases of over $13 million (*The Western News*, October 18, 1989, p. 24). It is not known how much of this money is spent within the project area. Expenditures for the Montanore Project probably would be similar.

Population Effects and Settlement Patterns

Table 4-37 shows total estimated population effects directly associated with development of the proposed project. The peak population impact is estimated to occur in 1993, with 411 people projected to have migrated into the project area. Of these, about 50 would be construction workers, 88 would be operations workers, 17 would be indirect employees, 110 would be spouses, and 146 would be children. This would be a population increase of slightly more than 2 percent over the 1988 Lincoln County

Table 4-37. Cumulative Montanore Project employment and population in migration—Lincoln County.

Project year	1	2	3	4	5
Calendar year	1991	1992	1993	1994	1995
Project employment					
Construction	170	190	90	0	0
Operations	30	130	440	450	450
In-migrating population					
Construction employees	94	105	50	0	0
Operations employees	6	26	88	90	90
Indirect employees	3	9	17	21	20
Spouses	63	89	110	85	84
Children					
K–8	25	41	66	57	57
9–12	11	17	28	24	24
Not in school	20	32	52	45	44
Total	222	319	411	322	319

Sources: IMS Inc. and Noranda Minerals Corp. 1989a.

population estimate of 18,700 persons.

Upon completion of the project construction phase (1993), the long-term population effect of project development is estimated to be about 319 in-migrants by 1995. This would be a population increase of slightly less than 2 percent of the 1988 Lincoln County population. If construction worker in-migrants or transients seeking jobs decide to stay in the area, long-term population effects could be slightly higher.

Specific impacts to local government units within the project area depend upon where in-migrants choose to reside. Workers generally want to live close to the project site to reduce commuting distance, provided that adequate public services and housing are available. Expected settlement patterns of in-migrating population are given in Table 4-38.

Peak cumulative in-migration would occur in Libby in 1992, with 116 total people moving to Libby. Peak cumulative in-migration into Troy and rural Lincoln County near Libby is expected in 1993, with 20 total people moving to Troy and 296 people moving to rural Lincoln County (Table 4-39). Peak increases over 1987 population estimates for each area would be 4.5 percent in Libby, 1.7 percent in Troy, and 1.9 percent in rural Lincoln County. By 1995, population increases due to development of the Montanore Project would be 48 people in Libby, 16 in Troy, and 256 in rural Lincoln County.

Table 4-38. Expected settlement patterns.

Area	Construction (% of total in-migrating workforce)	Operations (% of total in-migrating workforce)
Libby	45	15
Troy	5	5
Rural Lincoln County	50	80

Sources: Economic Consultants Northwest, 1989 and IMS Inc.

Community Services

Schools. The proposed project would affect schools in Lincoln County by increasing enrollment.

Table 4-39. Peak cumulative in-migration—Libby, Troy, and other Lincoln County areas.

	Libby					Troy					Other Lincoln County areas				
Project year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Calendar year	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Construction employees	42	47	22	0	0	5	5	2	0	0	47	52	25	0	0
Operations employees	1	4	13	14	14	0	1	4	5	5	5	21	70	72	72
Indirect employees	1	3	4	4	3	0	0	1	1	1	2	6	12	17	16
Spouses	27	33	26	13	13	3	4	6	4	4	33	51	79	68	67
Children															
K–8	10	13	14	9	9	1	2	3	3	3	14	25	50	46	46
9–12	4	6	6	4	4	1	1	1	1	1	6	11	21	19	19
Not in school	8	10	11	7	7	1	2	3	2	2	11	20	39	36	36
Total	93	116	96	51	50	11	15	20	16	16	118	186	296	258	256

Source: IMS Inc. 1990.

Assuming that children in rural Lincoln County would reside in the Libby School District, peak additional enrollment in this district would be 91 children, occurring in 1993. Comparison of 1988-89 enrollment with these additional students is presented in Table 4-40. Forecast enrollment increases of 64 students in grades K-8 and 27 students in grades 9-12 would result in total estimated enrollment of 1,570 students in K-8 and 622 students in 9-12. This would still be below current school facility capacity. While additional enrollment would maintain teacher/student ratios within Montana standards, local residents may wish to maintain the current quality of education by hiring additional teachers.

Development of the proposed project would bring in an estimated four additional students by 1993 to the Troy School District #1. With current total enrollment (not including special education) of 677 students, the additional four students resulting from Montanore Project development would create little impact on the District.

Law enforcement. The projected increase in population would create increased demand on the Lincoln County Sheriff's Department—increased traffic, vehicle accidents, and crime would create additional work for the deputies. Law enforcement problems in the project area could also result if transients migrate to the area seeking employment. Law enforcement officials have found that population in-migration tend to bring a significant increase in paperwork and problems arising from dogs (especially in rural areas).

Table 4-40. Additional enrollment in Libby School District #4.

Grades	K-8	9-12
1988-89 enrollment	1,506	595
Peak additional enrollment (1993)	64	27
Percent increase	4.2	4.5

Source: IMS Inc. 1990.

Current law enforcement staff is considered inadequate. The effects of the Montanore Project would aggravate the existing situation. Additional law enforcement staff would be needed to increase law enforcement.

Increased project traffic on U.S. 2 would require increased law enforcement by the Montana Highway Patrol. Increased population would aggravate the capacity problem at the existing Lincoln County jail in Libby. The facility is often filled to its capacity of 24 inmates.

Fire protection. The Libby and Troy Volunteer Fire Departments would incur an increased demand on staff and equipment due to population increase. Existing staff and equipment in the project area are considered adequate. The expected new population would not be enough to cause any significant fire protection concerns.

Ambulance services. The Libby and Troy Volunteer Ambulance Services would both experience additional emergency calls resulting from traffic accidents on U.S. 2 accidents would increase along with increase in population and commuting project employees. While this increase in emergency calls would place an additional strain on the existing level of service, impacts are not expected to be significant.

Hospitals and physicians. St. John's Community Hospital in Libby would experience a slight increase in admissions primarily because of traffic and project-related accidents. The hospital has adequate staff and facilities to meet this increased demand. The number of physicians in the area would be adequate to meet any increased demand resulting from project development.

Water supply. Approximately 2,000 households are currently served by the Libby water supply system. The estimated increase of 17 families would be readily accommodated by the existing system. Outside of Libby, water is supplied by private wells.

Ground water is adequate in existing residential areas near Libby to serve an estimated 72 additional families. However, water availability has not been proven for all potential residential locations.

Wastewater treatment. Since the Libby sewage treatment facility is currently operating at about 50 percent capacity, project related growth would easily be accommodated.

Residents in rural Lincoln County and Troy rely upon septic tanks for wastewater disposal. Potential problems due to construction and operation of new septic tank systems need to be evaluated on a case-specific basis.

Solid waste disposal. Residential and commercial refuse collection in Libby and Troy is handled by private contractors. Refuse is disposed of in municipal landfills in Libby and Troy. The Libby landfill would have sufficient capacity to handle the additional population resulting from project development. While the Troy facility cannot handle all types of wastes, any increase in demand for solid waste disposal in Troy can be handled by the Libby landfill if necessary.

Human services. Transient job seekers moving to the project area might increase the number of welfare recipients. Existing personnel can barely handle the current workload of welfare programs in the project area; additional demands would stress existing programs. However, it is also likely that development of the Montanore Project would offer employment opportunities to some persons currently using welfare and other human services, perhaps reducing the current resident workload.

Libraries. Public library use in Libby and Troy would increase due to in-migration of new population. Due to budget cuts in recent years, the library is barely able to meet current demands. Additional demand might force further reductions in library services.

Housing

The peak housing demand resulting from the Montanore Project would occur in 1993, when an estimated 153 construction, operations, and indirect workers would migrate into Lincoln County. Of these, 39 employees are projected to reside in Libby, seven in Troy, and 107 in rural Lincoln County, primarily near Libby. Assuming that each in-migrating worker represents one new household in the project area, Table 4-41 presents the number of total peak housing units needed by these workers.

The distinction between the types of workers is important because in-migrating construction workers tend to be more transient, and more generally require housing types such as apartments, mobile homes, or motel rooms. Operations and indirect workers tend to be more permanent, and more of these workers would make larger investments in housing, such as purchasing single family homes.

While the housing market is constantly changing,

Table 4-41. Worker residency patterns and housing needs.†

Worker type	Housing units needed	Peak year
Construction	105	1992
Libby	47	
Troy	5	
Rural Lincoln Co.	53	
Operations	90	1994 and beyond
Libby	13	
Troy	5	
Rural Lincoln Co.	72	
Indirect	21	1994
Libby	4	
Troy	1	
Rural Lincoln Co.	16	

Source: IMS Inc. and Noranda Minerals Corp. 1989a.
†Assumes one worker per housing unit.

rental housing such as apartments, motel rooms, and single-family homes have generally been in short supply in the project area in recent years. Without additional housing stock, it is expected that in-migrating workers would reside primarily in existing mobile homes and single-family homes obtained through purchase. Many operations workers would be able to afford home purchases with projected income levels. Construction workers and indirect workers would add to the existing competition for rental housing units. It is anticipated that a mobile home park or apartment building probably would be developed in the project area to meet possible housing shortfalls, especially during the construction period. At present, Noranda is not considering a construction camp for workers.

Worker in-migration and subsequent demand for much of the available housing stock would increase the cost of housing in the project area. The increased cost of housing would have the greatest impact on elderly or other fixed-income residents who do not directly benefit from revenues generated from the project. Any actual housing shortage or increases in housing costs probably would increase the need for social services. Overall, the availability of affordable housing is likely to be the single most important factor in determining employee settlement patterns.

Fiscal Effects

The proposed project would generate direct and indirect increases in government revenues. Affected jurisdictions, including Lincoln County, Libby, Troy, Libby School District #4, and Troy School District #1 would receive property tax receipts from one or more of the following sources—

- the assessed value of Noranda's mine/mill facilities;
- the value of the ore produced (gross proceeds taxable valuation); and/or
- the assessed value of new homes and businesses indirectly associated with project development.

The direct taxable value of the mine would increase during construction and reach its peak with full production scheduled for 1994. Total taxable value would then decrease slowly as the value of the mine and mill facility depreciates.

Some increases in local government costs are likely as a result of the mineral development itself. The costs to cities, school districts, and Lincoln County also would increase with each mine-related family that moves into the project area. Costs could take the form of additional capital outlays, personnel costs, and support costs for ongoing programs.

School districts and other local government units in Montana depend heavily on property taxes as their primary local source of revenue. Under normal circumstances, a local government unit may only tax property that is located within its geographic boundaries, which means that each local government unit in which a mine/mill is located would apply its own property tax mill levy to the entire taxable valuation of the mining operation. If the ore body and the mine and mill facilities were in separate taxing jurisdictions, each would tax only that portion of the mining operation located within its jurisdictional boundaries. Furthermore, taxable valuation derived from gross proceeds is normally considered part of the tax base of the jurisdiction where the ore body is located, regardless of where the extracted ore surfaces or is processed.

Montana legislation, however, allows for the "sharing" of tax revenue among local government units when a hard rock mine is designated as a large-scale mineral development. With tax base sharing, each "affected local government unit" may be allocated a portion of the total increase in taxable valuation of the mineral development, regardless of the location of the ore body or facilities. An affected local government unit can be a county, incorporated city or town, or school district.

The provisions of the Hard Rock Mining Impact Act, the Property Tax Base Sharing Act, the Metal Mines Reclamation Act, the Metalliferous Mines License Tax Act, and SB 410—

- define what constitutes a large-scale mineral development;
- identify the circumstances under which an Impact Plan would be required;
- identify the circumstances under which local government units would share the taxable valuation of a large-scale mineral development;
- define which local government units are potentially eligible tax base recipients;
- identify criteria for allocating taxable valuation (which determines the actual recipients, as well as the amount allocated to each);
- define what constitutes the property taxable valuation to be shared;
- suggest what might cause tax base sharing to terminate; and
- indicate how the Impact Plan and tax base sharing affect the allocation of the state's metal mines license tax revenues.

Tax base sharing occurs only when an approved Impact Plan identifies a "jurisdictional revenue disparity." As defined in the Tax Base Sharing Act, jurisdictional revenue disparity means on inequitable distribution of property tax revenues resulting from a large-scale hard-rock mineral development determined by the Hard Rock Mining Impact Board in an approved Impact Plan. If tax base sharing is required, each affected local government unit would apply its mill levy to its share of the taxable valuation. Allocation of taxable valuation would be based on the percentage of employees or school-age children residing within each affected local government unit. Tax base sharing may also affect the allocation of the state's annual metal mines license tax revenue designated for counties and school districts affected by mining projects.

The proposed Montanore Project qualifies as a "large-scale mineral development" requiring the development of an Impact Plan. Noranda is preparing a draft Impact Plan. The Impact Plan must be approved prior to Noranda's initiating activities under any operating permit issued by the Department of State Lands.

The Impact Plan will identify increased capital, operating and net operating costs to affected local governments resulting from the construction and operation of the mine. Noranda must pay all increased capital and net operating costs. Such payment would be made as property tax pre-payments, education impact bonds, grants, or other appropriate financing mechanisms. The plan may also provide that the developer furnish non-financial assistance, which may serve to forestall or reduce increased local government costs, or to ensure other benefits. The plan must contain a schedule of the developer's impact payments. Some commitments may be contingent upon the occurrence of specific events or circumstances.

The ultimate need for local government services and facilities would be affected by many variables, including changes in the timing or magnitude of development, the size or characteristics of the available local workforce, or the number of persons moving into the area as a result of development. Under tax base sharing, if local or in-migrating employees live in communities other than as projected in the Impact Plan, the allocation of taxable valuation and projected revenues would be altered. If actual revenue or expenses differ from projections, "if...then" provisions in the plan would allow for adjustments.

The inclusion of such conditional "if...then" provisions in the plan presupposes some degree of monitoring by the developer and the affected local government units. The impact plan might contain "if...then" provisions, depending on how the developer and local government choose to structure the plan. However, the Act does specify, and the plan may specify, conditions under which one or more parties to the plan may initiate an amendment. In any case, some degree of monitoring would be necessary to demonstrate the need for making changes to the approved impact plan.

Since the content and subsequent fiscal effects described within the Impact Plan are essentially a

negotiated agreement between Noranda and affected local government units, specific fiscal effects cannot be described at this time with any degree of certainty. Estimates of potential property tax revenues payable by Noranda are included in Table 4-42. Actual property tax revenues would depend on future mill levy rates, assessed taxable valuation, terms of the Impact Plan, production levels, mineral values, and allowable depreciation of Noranda property. Besides the estimated property tax revenues shown in Table 4-42, additional revenues would accrue to local governments from new residential and commercial property taxes, and other revenues from an increased population base. It is likely that Sanders County would receive no major tax revenues from Montanore Project development, due to anticipated terms in the Impact Plan. Generally, it is likely that local government costs associated with project development would be larger than revenues in the early years of the project. Revenues probably would be greater than costs in later project years.

Montana imposes two severance taxes on hard rock mines. Each of these taxes is based upon the gross value of the mineral produced. The resource indemnity trust tax rate of 0.5 percent is levied against gross value in excess of $5,000. The metal mines license tax is levied against gross value in excess of $250,000. The metal mines license tax rate is either 1.81 percent of the value of a concentrate shipped to a smelter, mill or reduction work, or 1.6 percent of any gold, silver, or platinum group metal shipped to a refinery. Assuming copper at $1.00 per pound and silver at $5.50 per ounce, annual metal mines license tax payments by Noranda could approach $2.8 million.

Twenty-five percent of the State's metal mines license tax revenue is allocated to the county in which the mine is located and through the county to the affected school districts. The county must reserve at

Table 4-42. Estimated direct property tax revenues from Montanore Project.

	Construction year			Operations year		
	1	2	3	4	5	6
Taxable Valuation ($000)						
Lincoln County	144	864	1,440	6,130	8,144	
Libby	36	216	360	1,532	2,036	
County-wide and Libby District school levies	180	1,080	1,800	7,662	10,180	
Property Tax Revenues ($000)						
Libby County		4.1	24.6	41.0	174.6	232.0
Libby		2.4	14.3	23.8	101.3	134.6
County-wide and Libby District school levies		35.7	214.1	356.8	1,518.8	2,018.0

Source: Noranda Minerals Corp. and IMS Inc.
Assumptions/notes:
1) Tax base sharing would occur between Lincoln County (80%) and Libby (20%).
2) No tax base sharing would occur between Libby and Troy school districts.
3) Payment of taxes would not occur until the year following assessment.
4) Copper is valued at $1 per pound, silver is valued at $5.50 per ounce.
5) Does not consider effects of any allowed depreciation.
6) The 1989-90 mill levy rates are used in the analysis.

least 40 percent of this revenue in a trust reserve account, which can be expended only following a 50 percent reduction in the mine's workforce or following the mine's closure. Fifty-eight percent of the metal mines license tax revenue is allocated to the State's general fund.

Hard rock mines that pay metal mines license taxes are not required to pay the Resource Indemnity Trust Tax. Instead, 15.5 percent of the State's metal mines license tax revenue is allocated to the Resource Indemnity Trust Fund. Interest from the RIT Fund is used to protect and restore the environment from damages resulting from mineral development. To compensate residents for the depletion of the State's mineral resource base, RIT interest is also used to provide other benefits, including development of the State's water resources.

Social Well-being and Quality of Life

The Montanore Project would have relatively minor effects on social well-being and quality of life in the project area. Mining and other natural resource development has been an important part of the local economy for many years. Integration of newcomers should occur relatively easily. Individuals and social groups within the community would perceive project-related benefits, such as increased economic opportunity, and costs such as social problems associated with population growth, from the perspective of their own values, beliefs and goals. Such perceptions would of course vary. Increased income within the project area would create new opportunities in the retail sales and service sector. Some residents believe the proposed project would revitalize and stabilize the depressed local economy.

Negative perceptions of project development may be attributed to people who are less dependent on the local economy, people who do not have an interest in community growth, and people with various other points of view. Many residents express anxiety at the prospect of a major mineral development project, based on their experience with and perceptions of other mining projects. These concerns are primarily—

- the Montanore Project might generate similar problems; and
- State and Federal agencies might not adequately monitoring and enforce applicable laws and regulations.

Persons having these views want their feelings known, but are not necessarily opposed to development of the Montanore Project.

Assumption Sensitivity Analysis

The results of the employment/population/income analysis described in the previous sections (termed the base case analysis in this discussion) are dependent upon a number of assumptions. If assumptions used in the analysis do not occur, the effects of Montanore Project would be different than those projected in the base case analysis. To show how assumptions affect the estimates of employment, population in-migration, and income, an alternative case was developed.

This alternative case consists of changes in the assumptions used in two important areas—the local (existing resident) hiring rate, and the indirect employment effects from the new project-related jobs. While the base case projection of 80 percent local hiring for operations workers is reasonable given current information, there are many external factors which could lessen the actual local hiring rate. There is also some uncertainty as to the proper indirect employment multipliers. Lincoln County has not had a major new project occur within its borders since the Troy Mine was developed in 1979, so there is little recent empirical data to use as a basis for this assumption. Indirect employment multipliers which are higher than those used in the base case analysis have been observed in other areas, and a 1982 study of Troy Mine economic impacts projected a Lincoln County multiplier of 0.8955 indirect workers for each new mining job. (ASARCO, Inc. and TAP, Inc., 1982). Consideration of these alternative

multipliers will help account for the uncertainty of the proper Lincoln County multipliers. The three specific assumption changes in the alternative case analysis include—

- the local (existing resident) hiring rate for operations workers is reduced from 80 percent in the base case to 50 percent in the alternative case;
- the indirect employment effects of basic Montanore construction employment is increased from 0.3 indirect workers per new construction job to 0.6 indirect workers per job; and
- the indirect employment effects of basic Montanore operations employment is increased from 0.45 indirect workers per new construction job to 0.9 indirect workers per job.

All other assumptions and data used in the base case are also used in this alternative case analysis.

Population effects of the analysis are presented in Table 4-43 (for Lincoln County as a whole) and Table 4-44 (for distributional effects in Libby, Troy, and rural Lincoln County). With these changes in assumptions, the peak Lincoln County cumulative population increase in 1993 due to Montanore development is 854 persons compared to 411 persons in the base case. Other alternative case results and comparisons to the base case analysis include—

- long-term Lincoln County population cumulative in-migration is estimated at 779 persons compared to 320 in the base case;
- peak cumulative indirect employment is estimated at 425 persons in 1994, compared to 210 in the base case;
- long-term cumulative indirect employment is estimated at 400 persons, compared to 200 in the base case;
- peak housing needs in Lincoln County are estimated at 304 units in 1993, compared to 153 units needed in the base case;
- long-term cumulative housing needs in the county are estimated at 266 units, compared to 111 in the base case;
- cumulative children in-migrating into the county are estimated at 324 children, compared to 146 children in the base case; and
- the estimated annual income (direct and indirect employees) resulting from Montanore Project development is estimated at $15.64 million, compared to $13.82 million in the base case.

From these comparisons, the importance of local hiring and indirect project effects can clearly be seen. Monitoring of employment, population, and income data would be necessary to determine the actual magnitude and duration of impacts.

Temporary or Permanent Closure

During construction and operation periods, the Montanore Project would provide a significant source of employment, income, and tax revenue. If the project were to close prematurely, employees would lose their jobs, thereby increasing

Table 4-43. Cumulative Montanore Project employment and population in-migration effects in Lincoln County–*Alternative case.*

Project year	1	2	3	4	5
Calendar year	1991	1992	1993	1994	1995
Project employment					
Construction	170	190	90	0	0
Operations	30	130	440	450	450
In-migrating population					
Construction employees	94	105	50	0	0
Operations employees	15	65	220	225	225
Indirect employees	6	18	34	43	41
Spouses	72	126	226	206	204
Children					
K–8	31	65	147	141	141
9–12	13	28	62	60	59
Not in school	24	51	115	110	109
Total	255	458	854	785	779

Source: IMS Inc. and Noranda Minerals Corp. 1989a.

unemployment and decreasing personal and governmental income. Actual effects would depend on the length of closure and unemployment benefits available to unemployed workers.

If operations proceed as currently planned, mining activities at the Montanore Project would cease in approximately 2010. When the mine is closed, the local area economy would lose 450 high-paying jobs. To help mitigate the fiscal and economic impacts resulting from mine workforce reduction and mine closure, the Hard Rock Impact Act (as amended by SB 410 in 1989) establishes a Hard Rock Mining Impact Trust Account. SB 410 provides counties and school districts with revenues that are to be held in trust to address both economic and fiscal impacts resulting from mine closure or from a major workforce reduction.

ALTERNATIVE 2

Noranda would develop written policies concerning local hiring and develop a worker training program. These policies and training program would seek to maximize local hiring, with the goal of obtaining at least 80 percent local hiring rate for operations workers, and 50 percent local hiring rate for construction workers. This would ensure a minimal number of new people moving to the area.

ALTERNATIVE 3

This alternative would have no distinct effect on the socioeconomic environment compared to the proposed alternative.

ALTERNATIVES 4, 5 AND 6

Selection of an alternate transmission line route would not change the overall socioeconomic effects discussed under Alternative 1.

ALTERNATIVE 7

Without the Montanore Project, economic benefits in both the private and public sectors would not be realized. New or existing residents would lose the economic development benefits from 450 jobs during

Table 4-44. Peak cumulative in-migration—Libby, Troy, and other Lincoln County areas—*Alternative case.*

	Libby					Troy					Other Lincoln County areas				
Project year	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Calendar year	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
Construction employees	42	47	22	0	0	5	5	2	0	0	47	52	25	0	0
Operations employees	2	10	33	34	34	1	3	11	11	11	12	52	176	180	180
Indirect employees	2	6	8	7	6	0	1	2	2	2	4	11	25	33	32
Spouses	29	40	44	31	31	4	6	11	10	10	40	80	170	164	163
Children															
K–8	11	18	26	21	21	2	3	7	7	7	18	45	114	113	113
9–12	5	7	11	9	9	1	1	3	3	3	8	19	48	48	48
Not in school	9	14	20	17	16	1	3	6	5	5	14	35	89	88	88
Total	100	142	164	119	117		22	42	38	38	143	294	647	626	624

Source: IMS Inc., 1990.

operations, 190 jobs during construction, and $13.82 million in annual income associated with long-term operations. These benefits are especially important given the potential shutdown of Troy Mine operations in the mid-1990s.

The long-term population increase of 320 people would not occur and the requisite community services and housing would not be needed. Population growth in Lincoln County would continue according to baseline projections shown in the Population and Demographics section under Socioeconomics in Chapter 3. Social conflict between those favoring the project and those opposed would gradually end. Persons who place a higher priority on environmental preservation and no population increases would perceive benefits resulting from the no action alternative.

CUMULATIVE IMPACTS

Beside the proposed Montanore Project, ASARCO's existing Troy Mine and the proposed Rock Creek project affect the Lincoln and Sanders Counties' present and future socioeconomic environment. Other mineral activities in the area—primarily small exploration projects—are not expected to lead to major development in the reasonably foreseeable future.

The Troy Mine in Lincoln County employs approximately 350 people with an annual payroll of $11.4 million. The Troy Mine may close as early as 1994 unless additional ore reserves are proven near existing facilities. According to a recent mine employee survey, 88 percent of the employees at the Troy Mine live in Lincoln County, 8 percent live in Sanders County, and 4 percent live in Idaho.

Another potential mine is located near Rock Creek, a few miles northwest of the proposed Montanore Project. ASARCO submitted an application to acquire an operating permit for the Rock Creek Project in May, 1987. The nearest town to the proposed Rock Creek development is Noxon, an unincorporated town on State U.S. 200 in Sanders County. Access to the Rock Creek mine would be from Noxon, and mine facilities also would be located in Sanders County. ASARCO estimates full production employment of 350 people, with an estimated annual payroll of $12 million. Based on permitting time frames and ASARCO's projected three-year construction period, the earliest the Rock Creek mine could go into production in late 1995. Mine life of the Rock Creek operation is estimated to be 30 years, nearly twice that of the proposed Montanore Project.

Total peak construction employment demand for the Rock Creek project would be 345 workers. It is estimated that about 30 employees, or 17 percent of the total in-migrating construction workforce for the Rock Creek mine would reside in Lincoln County. Including family dependents, this would amount to a total of 84 people. Total peak operations employment demand for the Rock Creek project would be 350 employees. Of the in-migrating workforce, about 8 percent, or six employees, would reside in Lincoln County. The total peak population increase in Lincoln County from the Rock Creek project after the construction phase is estimated to be about 20 people.

The peak population increase associated with Rock Creek development in Sanders County is projected to be 352 people during project construction. The projected long-term population increase in Sanders County attributable to the Rock Creek Project is estimated to be about 200 people. The vast majority of both positive and negative effects from Rock Creek development would occur in Sanders County.

A key factor determining the number of in-migrating workers for both the ASARCO Rock Creek Project and the Montanore Project is the fate of the ASARCO Troy Mine. Upon closure of the Troy Mine, a skilled workforce of 350 may be available either to the Rock Creek or Montanore project. Since the Montanore Project production start-up is expected in 1993 and Rock Creek operation may not begin until 1995, there would not necessarily be any major competition for former Troy workers.

However, since much of the Troy Mine workforce already lives in the Libby area (about 33 percent of total Troy Mine employment), some of these workers would be expected to seek employment with Noranda to avoid the longer commuting distance to the Rock Creek project. Assuming Troy Mine closure and Rock Creek project startup are relatively concurrent, many current Troy Mine workers would continue employment with ASARCO for the Rock Creek operation because of employee seniority and benefit vesting in ASARCO.

With the availability of the Troy Mine workforce for one or both of the new projects and current unemployment rates in Lincoln and Sanders counties, 80 percent local hiring for both projects would be still possible. If only one of the two projects is developed as planned (either Rock Creek or Montanore, but not both), the displaced Troy Mine workforce may provide a substantial amount of the needed workforce. If Rock Creek is developed, but the Montanore Project is not, some Lincoln County residents currently working at the Troy Mine may migrate to Sanders County to shorten their commute.

If the Troy Mine (with additional reserves extending the mine life), Rock Creek, and Montanore were all to operate concurrently—which is considered unlikely—the Troy Mine workforce would not be available to the two new projects, and the 80 percent local hiring assumption would probably not be met. This scenario would result in a larger population migration into Sanders and Lincoln counties than would result from to development of only one project. It also would result in the greatest level of community disruption.

Under the most likely situation, no in-migrating workers directly associated with the proposed Montanore Project are expected to reside in Sanders County. From a standpoint of cumulative impacts, therefore, the Montanore Project is not expected to have any direct effect on employment, population, or public services in Sanders County. Table 4-45 shows the relationship of future socioeconomic environments with projected population increases due to operation of both the Rock Creek and

Table 4-45. Cumulative population impacts.

Year	Projected baseline population	——Projected population growth—— Rock Creek Project	Montanore Project	Total
Lincoln County				
1990	18,760	0	25	18,785
1993	18,820	20	411	19,251
1995	18,860	30	320	19,210
2000	19,070	18	320	19,408
2005	19,340	18	320	19,678
2010	19,620	18	320	19,958
Sanders County				
1990	9,060	0	0	9,060
1993	9,320	80	0	9,400
1995	9,490	250	0	9,740
2000	9,800	200	0	10,000
2005	10,060	200	0	10,260
2010	10,370	200	0	10,570

Source: IMS Inc. 1990.

Montanore projects in Lincoln and Sanders counties.

RESOURCE COMMITMENTS

The project would alter the social and economic life of Libby and Lincoln County. Increased social conflict might develop between project proponents and project opponents. An estimated 450 people would be employed by the operation for 16 years. Increased population, some of which may be transient, coupled with the increase in requisite community services, may contribute to a disruption of present social conditions. Some social disruption may also occur following temporary or permanent project closure. Libby and Lincoln County, however, would continue to have considerable recreational qualities and social amenities valued by many residents.

CULTURAL RESOURCES

SUMMARY

Under Alternative 1, the proposed project would destroy historic site 24LN942, a collapsed log cabin, trail, two-track road and depression. Site 24LN942 is not eligible for nomination to the National Register of Historic Places and direct impacts to this site would not be considered adverse. No known prehistoric or Native American resources would be adversely affected by the project. No additional mitigation measures would be necessary for cultural resources in the mine and impoundment areas. Pedestrian surveys along the transmission line route, access roads, and substation site would be required.

Based on existing information, impacts under Alternatives 2, 3, 4, 5 and 6 would be the same as Alternative 1. Cultural resources survey of the final location for the transmission line and related access roads and clearance by the agencies would be required prior to line construction. Site 24LN942 would not be affected under Alternative 7.

ALTERNATIVE 1

Types of Impacts

An accepted classification of impacts to non-renewable cultural resources (Prehistoric, Historic and Native American) considers both direct and indirect impacts. Direct impacts are primarily the effects related to project construction, operation and maintenance. Indirect impacts are usually attributable to things such as better access and increased traffic to previously isolated sites, thus increasing the potential for vandalism. Direct and indirect impacts are classified as follows—

- no measurable direct or indirect impact;
- no adverse impact—measurable impacts which do not adversely affect a site's physical integrity or other criteria which would qualify a site for listing on the National Register of Historic Places (NRHP); or measurable impacts to a site not eligible for the NRHP; and
- adverse impact—measurable impacts which adversely affect the physical integrity or other NRHP qualifying criteria of the resource. Specifically, a site is adversely affected when its location, design, setting, materials, workmanship, "feeling," association or other characteristics which may qualify it as significant according to the National Register criteria, are changed. If a recorded cultural resource meets eligibility requirements for nomination to the NRHP, it is necessary to apply Criteria of Effect (36 CFR 800) to determine effects of the proposed project.

Affected Sites

Noranda's proposed project would destroy site 24LN942, including a collapsed log cabin, trail, two-track road, and depression. This site is not eligible for nomination to the National Register of Historic Places. Direct impacts to this site would not be considered adverse. Known prehistoric or Native American resources could be avoided through location of the substation, transmission line and access roads to avoid potentially adverse effects

ALTERNATIVES 2 AND 3

No mitigation measures would be necessary for cultural resources in mine-related facilities. The impacts would be the same as Alternative 1.

ALTERNATIVES 4, 5 AND 6

Based on existing cultural resources information, these alternatives would be identical in their cultural resources impacts. Noranda would conduct cultural resource surveys of all access roads and selected transmission line rights-of-way prior to construction. Important features identified by the survey would be avoided, where possible, or mitigation measures taken to ensure no loss of important cultural information when locating transmission line poles and access roads.

ALTERNATIVE 7

Historic site 24LN942 would not be affected.

CUMULATIVE IMPACTS

Cumulative impacts to cultural resources from the proposed Montanore Project could include the possibility of increased vandalism resulting from improved access to known, recorded historic resources. Cumulative impacts from other reasonably foreseeable developments, such as ASARCO's proposed Rock Creek mine, timber sales and other mineral activity are unknown because cultural resources in these areas have not been identified.

RESOURCE COMMITMENTS

The proposed project would irretrievably and irreversibly destroy one cultural resource. The resource that would be destroyed, however, is not unique and does not warrant inclusion into the National Register of Historic Places.

NOISE, ELECTRICAL FIELDS, RADIO AND TV EFFECTS

SUMMARY

Selection of Alternative 1 would result in noise impacts from stationary and non-stationary noise sources during mine development and operation. Stationary equipment such as crushers, ventilation fans and generators, and non-stationary equipment such as dozers, rock trucks and loaders, have a 7,000-foot zone of audibility feet under worst case conditions. Taking the effects of surface absorption and topography into consideration, the zone of audibility would be reduced to less than one mile. Vehicles traveling from the Ramsey Creek plant site along the Bear Creek Road and U.S. 2 to Libby would increase noise levels along these corridors.

Mitigation measures associated with Alternatives 2 and would minimize noise impacts from ventilation fans and construction activities. There would be no difference in effects between transmission line Alternatives 4, 5 or 6 and Alternative 1. Alternative 7 would eliminate all noise impacts associated with construction and operation.

ALTERNATIVE 1

Noise Sources and Effects

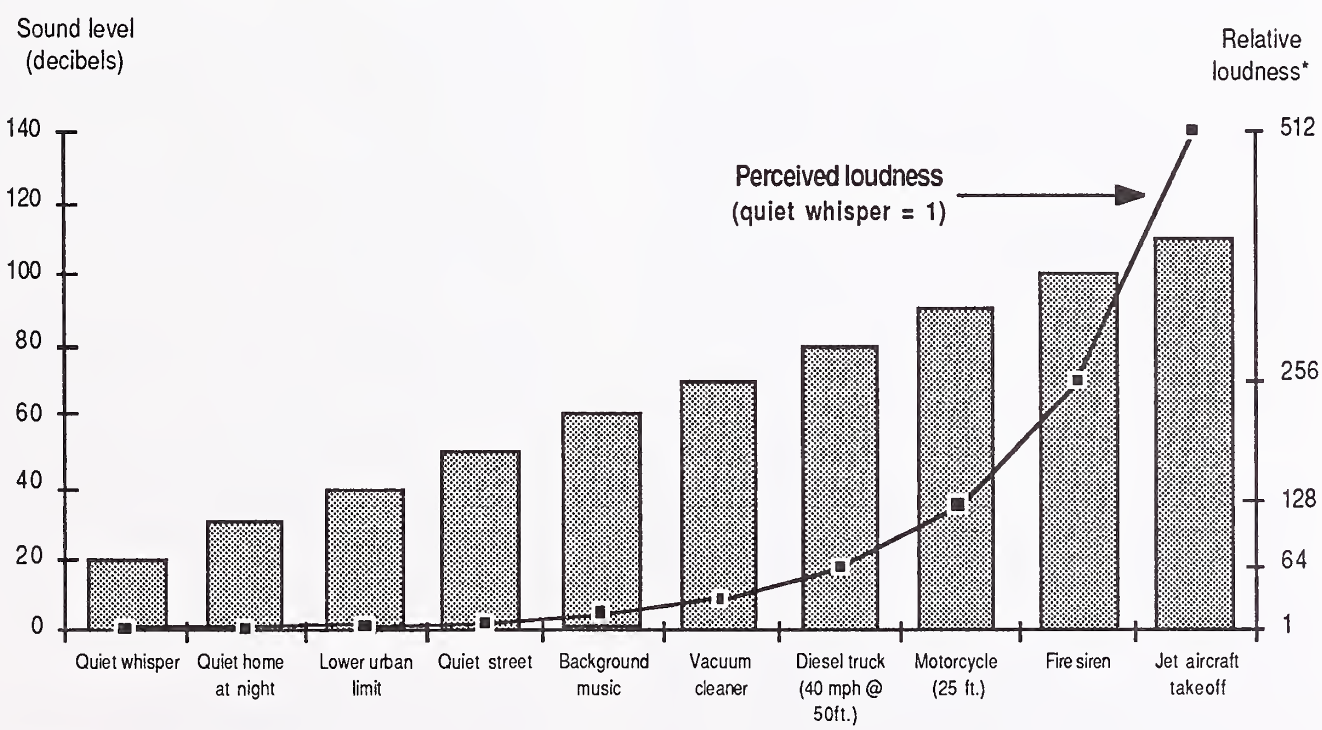
Ambient noise. Noranda's proposal would increase the ambient noise levels in the area around the plant site and portals. Noise levels also would increase along the haul route. Existing minimum ambient noise levels at the Ramsey Creek site and at the Cherry Creek site range from levels as low as 22 dB(A) in the nighttime to 35 dB(A) during the daytime. Occurrences of higher natural ambient noise levels are caused by such things as wind, rustling foliage, insects, birds and other wildlife, thunder, and rain. Levels of typical noise sources and their relative loudness are shown in Figure 4-10.

Construction and operations noise. Highest noise levels would be generated at the plant site, with maximum sound levels reaching up to 125 dB(A) at 900 feet for short periods as a result of blasting. Blasting noise would be greatest during initial adit construction; as the adits go deeper, blasting noise would decrease. Other sources of sound at the plant site would include trucks, bulldozers and other equipment or vehicles during construction and operations. Typical noise levels from construction equipment range from 110 to 120 dB(A) at 50 feet. Equipment used during operations would generate less noise, ranging from 80 to 90 dB(A).

Noise would also be constantly generated by ventilation fans. Following construction, ventilation fans would be set inside the adits to minimize noise levels.

Noise at the tailings impoundment and percolation

Figure 4-10. Perceived loudness relative to measured noise levels.



*Perceived loudness doubles with every 10 dB increase in sound level. A quiet whisper [20 dB(A)] is arbitrarily assigned a relative loudness value of 1.

Source: IMS Inc. 1990.

ponds would be generated by heavy equipment during construction and by occasional vehicular traffic, pumps and associated equipment, and bulldozers during operations. The sound from bulldozers would be periodic.

Because the ambient sound levels throughout the mine area are low, the zone of audibility associated with the mining operation would extend about one mile around each project facility. Haul trucks with inadequate mufflers may be audible up to two miles.

Transmission line construction noise. Transmission line construction would temporarily increase daytime ambient noise levels along the transmission line corridor. During the estimated four-month transmission line construction period, construction equipment such as bulldozers, loaders, and haul trucks would generate 100 to 120 dB(A) at 50 feet. Chain saws and logging trucks used in forest clearing for the line would generate similar noise levels (Noranda Minerals Corp., 1989a). These sounds would generally occur in hilly, forested areas, which serve to reduce sound audibility. If a helicopter is used for line stringing, its noise would be widely audible for an estimated one-week period.

Because of generally low ambient background noise levels, the transmission line clearing, road construction, and line construction activities would be generally audible for approximately one mile. Equipment trucks or logging trucks with inadequate mufflers or Jake brakes could extend the audible area. All off-site truck traffic would temporarily increase noise levels at residences adjacent to travel routes to and from the construction area. The effects would be similar to logging trucks transporting logs from an active timber sale area.

Transmission line noise. The proposed 230-kV electrical power transmission line would produce soft hissing and crackling sounds in wet weather. In fair weather, these noises are virtually inaudible. During the light rains or wet snows which occur about 10 percent of the time in the project area, the Montanore Project transmission line would produce a noise level of about 43 dB(A) at the edge of the right-of-way (Noranda Minerals Corp., 1989c). This sound level is slightly above naturally occurring levels and would be only faintly discernable. During operation, noise from the substation would be faintly discernable beyond the fenced site.

Transportation noise. Haul trucks operating on the access roads would produce sound levels of 86 dB(A) at 50 feet for trucks with properly maintained mufflers. Trucks using Jake brakes with straight pipe mufflers would produce sound levels of 98 dB(A) at 50 feet, and would be audible at distances of up to, but generally not exceeding, one mile. These haul trucks would affect residences adjacent to the haul route. The impact would be the most at night.

Cabinet Mountains Wilderness. Sound generated at the plant site would be audible inside the Cabinet Mountains Wilderness. The wilderness boundary is about 0.5 mile west and about 0.75 miles north and south of the proposed plant site. The ridge that surrounds the plant site, all of which is within the wilderness, ranges in elevation from 6,400 feet on the north to over 7,900 feet (Elephant Peak) on the west. Equipment with sound levels of 115 dB(A) would be audible at locations within one mile of the plant. The ridges to the north and south of the plant site are difficult to reach and probably have little human occupancy. The ridge to the west is two miles away and about 3,000 feet higher than the plant site. Elephant Peak, a destination peak for mountain climbers, is on this ridge. Most mining-related noise would not be audible on Elephant Peak. During initial adit construction, occasional blasting noise might be audible.

Electric and Magnetic Fields

The Montanore Project transmission line would generate electric and magnetic fields. These fields pose no known risk to vegetation, livestock, or wildlife. They may, however, induce a current in ungrounded metal objects such as fences crossed by

the right-of-way. A person touching an ungrounded object might receive a mild shock, much like that received when touching a metal doorknob after crossing a carpet. Noranda would ground all metal fences or structures crossed by the transmission line to minimize nuisance shocks.

Under a maximum load of 125 amps, the proposed 230-kV transmission line would produce an electric field strength at the edge of the right-of-way of about 0.75 kilovolt per square meter (below the Montana standard of 1.0 kV/m^2). The line would produce a magnetic field strength of about 5 milligauss at the edge of the right-of-way (Noranda Minerals Corp., 1989c). Although these field strengths are no greater than those produced by household appliances, there is clear evidence that the fields themselves can produce subtle hormonal and chemical changes in living organisms. It is not yet clear if these changes constitute a risk to public health.

Extensive research has been conducted on the human health implications of electromagnetic fields, and many more studies are underway. The results so far are complex and ambiguous. The scientific community does not yet agree on whether the fields pose a risk to human health and, if they do, how serious that risk might be. Continuing research should help reduce some of the present uncertainty (Morgan, 1989). Most risk studies have focused on the chronic, long-term exposure to electromagnetic fields experienced by people living next to lines. The proposed transmission line would be located at least 500 feet from existing residences, far enough away that these fields would not be a factor. Most human exposure would be short-term and occur as highway travelers or forest users pass under or near the facility. This brief exposure is not expected to have any effect on people's health.

Electric fields at the substation sites would be dominated by the fields created by the transmission lines passing through the substation. Exposure to these fields is expected to be short-term and would not be likely to have any adverse effects on the public's health.

Radio and TV Interference

The transmission line would generate radio noise which may interfere with AM radio and television reception close to the line. FM broadcasts and 2-way communications are generally not affected. Depending on the line's final engineering design, radio-generated noise levels would be between 40 and 65 decibels at the edge of the right-of-way. The effect of the line on AM radio and TV interference decreases rapidly as distance from the line increases. At any residence which more than 600 feet from the location of line, radio and TV interference is not expected to be a problem. TV interference is only likely to occur if the line is within 500 feet of a residence and the conductor is in the path of the TV signal. If interference do occur once the line is energized, Noranda or the operating utility would correct this as required by Federal Communication Commission regulations. Correction of the problem would depend on site specific circumstances but measures such as installation of remote antennae could correct most problems. According to FCC regulations, the line must not degrade radio or TV reception beyond current levels. Possible radio and TV interference problems along the transmission line normally cannot be accurately identified until the final line location and design are known.

ALTERNATIVE 2

Noranda would ensure all equipment has properly maintained mufflers and other noise control equipment. Noise levels associated with equipment would be less than the EPA standard. This measure would ensure acceptable noise levels at the project facilities and along the access road.

Where possible, backup beepers would be replaced with the strobe light-type warning devices and the sound level of the backup beepers would be reduced to less than the normal 110 dB(A) at 10 feet.

Regulations stipulate that the sound level of backup beepers must be audible in affected work areas. Sound levels of 90 to 100 dB(A) at 10 feet would provide audible warning at distances up to 50 feet behind a large front end loader.

Noranda would install a sound attenuator on all ventilation fans. Noranda would also design and submit for agency approval an earthen berm on the west side of the Ramsey Creek portal. These measures would reduce the noise associated with the Ramsey Creek facilities. Other impacts would be the same as Alternative 1.

ALTERNATIVE 3

The noise impact changes associated with this alternative would be the elimination of the noise that would be produced by the equipment used for construction of the percolation ponds. This would not be a significant difference. Other impacts would be the same as Alternatives 1 and 2.

ALTERNATIVES 4, 5 AND 6

There would be no difference in noise, electric and magnetic fields, and radio and television interference between the proposed transmission corridors and the other alternatives.

ALTERNATIVE 7

This alternative would eliminate all noise impacts associated with the proposed mining operation.

CUMULATIVE IMPACTS

Traffic noise at various distances was estimated using a computer simulation technique, and monitored and projected traffic levels on the Bear Creek Road and U.S. 2 (Table 4-46). Estimates were conducted for baseline mine related traffic, and for baseline, mine and logging traffic. Cumulative noise levels would be increased about 20 decibels on the Bear Creek Road and 15 decibels on U.S. 2 over baseline conditions.

Table 4-46. Equivalent noise levels on Bear Creek Road and U.S. 2 with and without mining and logging impacts.†

Distance from roadway (ft.)	Traffic baseline	Baseline + mining	Baseline + mining + logging
	L_{eq} in dB(A)		
Bear Creek Road			
50	60.1	67.4	78.5
200	50.5	57.9	69.8
800	40.7	48.0	59.9
3,200	28.0	35.2	47.2
U.S. 2			
50	64.6	71.3	78.4
200	55.1	61.8	69.6
800	45.3	51.9	59.7
3,200	32.6	39.1	47.0

Source: IMS Inc., using Fed. Hwy. Adm. STAMINA 2.0/Optima program.
†Assumed maximum vehicle speed on Bear Creek Road is 35 mph; on U.S. 2, 55 mph for cars, 45 mph for trucks.

ASARCO's proposed Rock Creek project would not be close enough to the proposed Montanore Project to cause a cumulative noise impact. Because these projects use different access and haul routes, transportation noise associated with these projects would not be cumulative.

RESOURCE COMMITMENTS

During construction and operation of the mine, sound levels would be higher throughout the project area and in the Cabinet Mountains Wilderness than at present. Following mine closure, sound levels would return to pre-mine levels.

TRANSMISSION LINE NEED, COST AND RELIABILITY

SUMMARY

The mine would not be able to operate without a power supply. A 230-kV transmission line connecting the mine to the existing Noxon-Libby 230-kV line would supply the mine at the lowest cost.

The power line is estimated to cost $2.6 million to $2.8 million to build. Noranda's annual power cost would be approximately $9.3 million. Of the alternatives analyzed in detail, Alternative 5 would be slightly cheaper, while Alternative 1 would have fewer poles at high altitudes.

ALL TRANSMISSION LINE ALTERNATIVES

Need

To find that the transmission line is needed, the Board of Natural Resources and Conservation, must determine that the capacity of the line is needed within 2 years, or, if less capacity is needed, that the difference in benefits and costs justifies building the larger line [ARM 36.7.3506 (1)].

There is no transmission line to the site. Without the proposed line or one of the alternative lines, the mine could not operate. The mine could operate with a 115-kV line rather than the proposed 230-kV line. A lower voltage line, however, would cost more to build and operate. A lower voltage line to the mine would require an additional transformer to change the voltage and also would have higher line losses, four times higher than a 230-kV line. A 230-kV voltage line appears to be the most cost effective for the proposed mine loads.

If all electrical equipment at the mine site were operated at once, the load would be 50 MW. However, Noranda expects the actual peak load to be 40 MW. The annual energy use at the mine is expected to be 274 million kilowatt-hours. Noranda's annual electricity cost would be approximately $9.3 million.

If the mine is profitable over its lifetime, the benefits of the transmission line almost certainly exceed the costs. If the mine is not profitable and is not operated as planned, the benefits might not be greater than the costs. In either case, the benefits and costs would primarily accrue to Noranda. Neither utility rate payers nor the general public face a risk of higher costs associated with the transmission line if unexpected circumstances cause a change in planned mine operations.

Costs/Benefits

The initial cost of building a line to the mine would be between $2.6 million and $3.0 million, depending on which route is chosen (Table 4-47). Annual operating and maintenance costs normally would be $1,400 to $1,600. Noranda would pay the cost of building, operating, and maintaining the line.

Reliability Considerations

Power outages at the mine would not cause safety problems but would have costs. Noranda plans to have back-up generators with capacity of 7 MW at the mine site. This would be adequate power to maintain ventilation, pumping, and lighting in the mine, but would not allow any mining or ore processing. A power outage would shut down the ore processing equipment, and up to an hour would be needed to restart it after even a very short outage (E. Netherton, Electrical Engineering consultant, Redpath Engineering Corp., January 3, 1990).

Alternatives 1 and 4 cross less high altitude terrain than the Alternatives 5 and 6 routes. A higher, more exposed route would be more likely to suffer from a major lightning-caused outage and might be more subject to problems from snow and ice build-up, although not enough data to quantify these differences. Deep snow also may make access to the line expensive in winter. Snow accumulation in this area increases rapidly with altitude. Conventional snow plows could open access roads covered by up to two or three feet of snow, but deeper snow or drifts would have to be removed with truck- or tractor-powered snow blowers. This is slower and much more expensive than plowing. Plowing costs about $3 per mile while blowing snow costs about $.30 per cubic yard (Miller, 1990). The number of poles that would be located at altitudes where snow accumulations of 2, 4, and 6 feet are likely is shown in Table 4-48.

Table 4-47. Costs of various transmission line components.

Cost component	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Transmission line				
Length (miles)	16.3	16.4	15.9	17.2
Construction cost ($ million)	2.62	2.62	2.55	2.76
Annual maintenance ($)	1,400	1,400	1,400	1,500
Extra line losses/yr† ($)	300	300	0	900
Life cycle cost ($ million)	2.64	2.64	2.57	2.79
Substations* ($ millions)				
Sedlak Park	1.63	same	same	same
Ramsey Creek	2.81	same	same	same

Source: Noranda Minerals Corp. 1989c.

†All routes have line losses. The value given is the difference between losses for the given route and Alternative 5, the shortest route.

*Costs for substation equipment are preliminary estimates which may change due to final engineering design work being done by Noranda and BPA.

Table 4-48. Approximate number of poles above critical altitudes.

	Alternative 1	Alternative 4	Alternative 5	Alternative 6
Below 3,600 feet (less than 2 ft snow)	51	51	51	57
3,601 to 4,000 feet (2 to 4 ft snow)	11	14	10	12
4,001 to 4,500 feet (4 to 6 ft snow)	28	29	18	22
Above 4,501 feet (over 6 ft snow)	3	3	21	26
	93	97	100	117

Source: Compiled by Department of Natural Resources and Conservation
Based on snow course survey information from Soil Conservation Service, Bozeman, MT.

5

COMPARISON OF ALTERNATIVES

THE alternatives analyzed in this EIS were developed in response to the significant issues identified during scoping. The agencies identified six significant environmental issues to drive the development of alternatives and evaluation of impacts—

- Issue 1—Changes in wildlife habitat and population, particularly the threatened grizzly bear;
- Issue 2—Changes in the type and quality of general forest recreational activity and on the area's aesthetic qualities;
- Issue 3—Changes in the Cabinet Mountain Wilderness character, such as opportunity for solitude, natural integrity, and opportunity for primitive recreation;
- Issue 4—Socioeconomic changes, including employment, income, housing, community services, population, and public finance;
- Issue 5—Concerns about the location and stability of the tailings impoundment; and
- Issue 6—Changes in quality and quantity of water resources.

Table 5-1, presented later in this chapter, provides a side-by-side comparison of the effects of the seven alternatives analyzed. Detailed descriptions of these alternatives are given in Chapter 2, and a detailed discussion of their impacts is in Chapter 4.

Alternative 1 is the mining operation and transmission line as proposed by Noranda. Alternative 7 is a No Action alternative—in other words, permits would be denied and the Montanore Project would not be constructed. If neither of these alternatives is selected, the agencies would select from among two mine alternatives (Alternative 2 or 3) and three transmission line alternatives (Alternative 4, 5, or 6).

CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES

As proposed, the Montanore Project would result in significant impacts in three areas—surface water quality, wildlife habitat, and general forest

recreational activity. Some changes also would occur in the socioeconomic environment of Lincoln County and Libby, and in wilderness attributes in the Cabinet Mountains Wilderness. These changes are described in the following sections. Based on the agencies' analysis, Alternatives 3 and 6 would have fewer adverse environmental effects than other alternatives. The agencies will identify a preferred alternative for the mine and transmission line in the final EIS.

Changes in Surface Water Quality

Alternative 1 may violate water quality standards during initial mine development and prior to mill operation (Years 2 to 3 of the construction period). The standards would only be violated during annual periods of low flow. Additional measures described in Alternative 2 and 3, that would meet water quality standards, would be undertaken.

Under Alternative 1, Noranda would implement a monitoring program designed to evaluate compliance with applicable regulatory standards. The monitoring program is also designed to develop information on water management, particularly on the quantity and quality of tailings impoundment seepage and mine inflows. Noranda would revise the proposed water management plan in response to the monitoring information.

As part of Alternative 2, the agencies have expanded the monitoring program in response to uncertainty perceived in Noranda's proposal. In addition to measures proposed by Noranda, Noranda would be required to design and seek agency approval of a detailed water management plan to ensure surface water quality standards are maintained for all phases of the project.

Under Alternative 3, Noranda would construct a series of gravel drains beneath the tailings impoundment and dam to intercept seepage prior to entering ground water. The drain system, which would cost about $1.5 million, would be coupled with a water treatment system. Three water treatment alternatives have been developed and described. Based on treating 950 gpm of mine and adit water for a short-term period (three years during construction), conceptual capital costs of the alternatives would range from about $3 million for a wetland system to about $12 million for an evaporator system. Treatment of tailings seepage during operations would have capital costs about one-third of these amounts. Operating costs for all treatment systems would be higher. Final design of a treatment system may result in revised costs. No standards would be exceeded following treatment by any of the three systems. A waiver to the non-degradation provisions would be required for all systems. The transmission line alternatives would have little effect on surface water resources.

Changes in Wildlife Habitat

The Cabinet Mountains provide habitat for a small population of grizzly bears, a threatened species. The project area also provides habitat for a variety of big game wildlife, such as elk, moose, black bear and mountain goat. Mining and increased activity such as general recreation and hunting, would displace these species from some of the habitat presently used in the project area. Other wildlife impacts would be similar for Alternatives 2 through 6.

Noranda would replace affected grizzly bear habitat through road closures, habitat acquisition, or habitat enhancement and protection. Noranda has proposed that the KNF implement year-round closure of three National Forest System roads (10.9 miles) and seasonal closure of four National Forest System roads (20.1 miles). The KNF has two of these roads (5.8 miles) under consideration for permanent closure. These road closures may provide the necessary replacement for the grizzly bear habitat that would be affected by the project. Noranda would replace habitat not compensated by road closures by acquiring conservation easements on suitable private

land over an 11-year period and then administering easements over the life of the project.

Increased human-caused grizzly bear mortality, would be an indirect effect of the project. Under Alternative 1, Noranda would fund the salaries of two wildlife professionals; one would be responsible for law enforcement and one would develop and implement an educational and informational program. Noranda would also support selective changes in the hunting regulations to reduce mortality risk. Road closures might reduce mortality.

Under the remaining action alternatives, impacts to grizzly bears would be the same. The agencies developed an alternative grizzly bear mitigation plan, which would be implemented if Alternative 2 or 3 is selected. All affected habitat would be replaced through habitat acquisition of nearly 4,700 acres over a four-year period. Under Alternative 2 or 3, Noranda would fund the salaries of two wildlife professionals from the Montana Department of Fish, Wildlife and Parks for increased information and education, and law enforcement programs. A detailed information and education program would be implemented.

Changes in wildlife habitat resulting from the project would not occur under Alternative 7. The grizzly bear recovery plan currently being implemented in the Cabinet Mountains would continue.

Changes in General Forest Recreational Activity

During the construction phase of the project, a significant increase in traffic would occur on the Libby Creek and Bear Creek roads. The Bear Creek Road would be widened to accommodate the increased traffic. The increased traffic would likely affect those recreational users who use the forest for travel and viewing pleasure, the primary recreational use in the project area. Road closures, both those proposed by Noranda for grizzly bear mitigation (see next section), and those under consideration by the KNF to comply with KNF Forest Plan standards, would further reduce motorized recreational opportunity. Some of the roads proposed for closure are in areas managed for non-motorized recreation. Closure would increase semi-primitive, non-motorized recreational opportunity.

The 595-acre tailings disposal facility (impoundment and dam) would be permanent and would affect the views of the Cabinet Mountains from several locations along Libby Creek Road. Although Noranda's proposed reclamation plan would likely result in reforestation of the impoundment area, the landform which would be created by the facility would remain incongruent with the surrounding landscape.

The impoundment and other project facilities, such as the plant site and transmission line, would also be visible from locations within the Cabinet Mountains Wilderness. The transmission line would be visible from the Libby Creek Recreation Gold Panning Area and the Howard Lake Campground.

Alternatives developed by the agencies are intended to reduce or avoid these potential impacts. Under Alternatives 2 and 3, Noranda would develop a mandatory busing program to be implemented during the operation phase and a transportation plan for the construction phase to reduce traffic on the access roads. This mitigation would significantly reduce traffic levels.

Noranda would implement several modifications to address potential visual effects as part of Alternatives 2 and 3. The two primary modifications are development of three additional viewpoints along the Bear Creek and Libby Creek roads with views focusing on the Cabinet Mountains and development of a roadside tree management program with the goal of obscuring any project facilities along primary travel routes.

The transmission line would be routed away from developed portions within the Libby Creek Recreation Gold Panning Area under the transmission line alternatives (4, 5 and 6). Transmission line Alternatives 5 and 6 would reduce visual impacts from the Howard Lake area.

Changes in the Socioeconomic Environment

Operation of the Montanore Project would create 450 new jobs, and increased business activity in Lincoln County would create another 200 jobs. Employment during the three-year construction phase would be slightly higher. About $13.8 million in annual personal income would result from project operations. A long-term population increase estimated to be 319 people would be less than two percent of the present population in Lincoln County. A peak population increase of 411 people would occur during the construction phase. Increased housing and community services would be necessary to accommodate increased growth. An estimated 90 housing units would be needed by project workers and their families during the operations period; 105 housing units would be needed during the construction phase. No work camps would be developed. Under the Hard Rock Mining Impact Plan, Noranda would pay for all increased costs to local government units resulting from the project.

Under Alternative 7, these socioeconomic changes would not occur. Existing high unemployment levels would likely remain.

Changes in Cabinet Mountains Wilderness

The proposed project would be near the Cabinet Mountains Wilderness, with the proposed plant site and adits adjacent to the wilderness boundary in Ramsey Creek. Current recreational users of the Ramsey Creek drainage seeking the opportunity for solitude and primitive recreation, would likely be displaced. Access to upper Ramsey Creek above the plant site would be restricted. Project facilities would affect the views of climbers of some wilderness peaks (~150 people).

Increased noise levels, particularly during construction, and increased concentrations of air-borne pollutants would occur in upper Ramsey Creek. Levels of air-borne pollutants are expected to be well below applicable standards. No subsidence and no effects to surface water resources is expected in the wilderness.

Under Alternatives 2 and 3, some noise reduction would occur through mitigation. Increased monitoring would occur for surface and ground water resources, and for air quality around the proposed plant site. The transmission line alternatives would not affect wilderness characteristics.

Under Alternative 7, the current characteristics of the Cabinet Mountains Wilderness would remain. Areas around the proposed plant site would not be affected.

TRANSMISSION LINE ROUTE AND FINAL CENTERLINE SELECTION

The DNRC and the KNF are seeking comment from the public regarding the analysis of alternative routes and areas for additional centerline analysis within the routes shown on Figure 2-1. Additional fieldwork by the agencies and new information that became available after publication of the draft EIS might change the location of the centerline shown in Figure 2-1. The final EIS will present any changes made in these locations. The final EIS also will contain DNRC and KNF recommendations to the BNRC regarding a preferred route and recommended centerline location. The BNRC will select a route through contested case hearing proceedings discussed in Chapter 1.

In selecting a preferred route and final centerline, the Board of Natural Resources and Conservation (BNRC) would use preferred route criteria established by administrative rules. Preferred route criteria encourage the use of public lands for a transmission line and require the best achievable balance among a number of environmental and location factors. Table 5-2 lists the preferred route criteria adopted by the BNRC.

The DNRC and the KNF considered these criteria during the preparation of the draft EIS when analyzing impacts and comparing the transmission line alternative routes in Chapter 4. In evaluating and comparing the alternative routes, the DNRC and the KNF noted both similarities and differences in how well each route met the preferred route criteria. Table 5-3 presents a summary comparison of the alternative routes based on the BNRC-preferred route criteria and impact analysis contained in Chapter 4.

Alternatives 4, 5, and 6 offer environmentally sound locations for the transmission line and minimize environmental impacts considering the nature and economics of the alternatives. Alternative 1, construction of the transmission line as proposed by Noranda, would result in the greatest environmental effects due to the use of a crawler tractor rather than a helicopter to pull the sock line during initial stringing operations. Based on the preferred route criteria and analysis of impacts contained in Chapter 4, Alternative 6—Swamp Creek provides the best balance among the applicable route criteria. Alternative 5—North Miller Creek provides the next best balance. Alternative 4—Mitigated Miller Creek ranks third among these alternatives, followed by Alternative 1—Miller Creek.

Table 5-1. Comparison of alternatives by significant environmental issue.

ISSUE	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	ALTERNATIVE 7
Cabinet Mountains Wilderness							
Opportunity for solitude and primitive recreation	Recreational users of upper Ramsey Creek (~75 summer users) displaced. Project facilities would affect views of wilderness peaks climbers (~150 people).	Mine effect similar to Alternative 1.	Mine effect similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Current wilderness experience remains unaffected.
Natural integrity and apparent naturalness	Increases in concentrations of air-borne pollutants in upper Ramsey Creek. Expected levels well below applicable standards. Increased noise levels, particularly during construction, in upper Ramsey Creek. No air quality or visibility impacts. No subsidence or effects to surface water resources in Cabinet Mountains Wilderness expected.	Some noise reduction in wilderness through mitigation measures, such as berming around ventilation fans, adding sound attenuators on ventilation fans, and modification of backup beepers on equipment. Increased monitoring of surface and ground water resources and air quality during operations. Other mine impacts the same.	Mine impacts same as Alternative 2.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Natural integrity and apparent naturalness maintained. Water resources in wilderness not at risk.
General Forest Activities							
Recreational opportunity and use	Displacement of recreational uses from Libby, Ramsey and Poorman drainages. Increased crowding at Howard Lake Campground and Libby Creek Recreation Gold Panning Area. Road closures would modify motorized recreational opportunity to semi-primitive, non-motorized recreational opportunity. Moderate or high visual impact from project facilities to key viewpoints within forest; transmission line visible from Libby Creek Recreation Gold Panning Area and Howard Lake Campground.	Impacts similar to Alternative 1. Noranda would accomplish or fund the following mitigation— Great Northern Mountain Trail would be reconstructed; Parking areas near Leigh Lake trail head established; Improvements made at the Howard Lake Campground and Libby Creek Recreation Gold Panning Area; and Roadside tree management program developed to obscure views of tailings impoundment and increase views of Cabinet Mountains.	Mine impacts same as Alternative 2.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	Transmission line effects similar to Alternative 1.	No displacement of users. Developed recreational area use remains at current levels. Bear Creek Road not widened.

Table 5-1. Comparison of alternatives by significant environmental issue (cont'd).

ISSUE	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	ALTERNATIVE 7
General Forest Activities (cont'd)							
Other forest uses (also see Wildlife)	Temporary disturbance of 1,225 acres; 595-acre tailings impoundment and 22-acre Bear Creek Road improvements unsuitable for timber harvesting following operations. Increased traffic on Bear Creek Road (500%); road widened to accommodate increased traffic, increasing access.	Traffic significantly reduced by mandatory busing. Bear Creek Road returned to pre-mine width. Other mine impacts same as Alternative 1.	Mine impacts same as Alternative 2.	Less clearing necessary for line construction.	Less clearing necessary for line construction.	Less clearing necessary for line construction.	Existing multiple uses in project area remain.
Water Resources							
Surface water quality	Slight increases (below applicable standards) in metals, nutrients and total dissolved solids concentrations in project area streams from seepage and discharges during operations; Discharges during 3-year period prior to mill start would violate standards for copper and manganese. Noranda would construct a seepage interception system consisting of a series of wells downstream of the impoundment. Adit discharge quality following operations unknown.	Noranda would design and submit to agencies for approval a detailed plan to ensure surface water quality standards are maintained. Increased monitoring of surface and ground water resources during operations. Comprehensive mitigation plan implemented.	Most seepage collected by drain system prior to entering ground water. Excess water and seepage treated; Only slight increases in total dissolved solids, nutrient, and manganese. Not standards violated.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	Existing surface water quality maintained.
Surface water quantity	Slight increase of flow in Libby Creek. No subsidence or effects to surface water resources in Cabinet Mountains Wilderness expected.	Increased monitoring evaluating mining effects on surface water resources in Cabinet Mountains Wilderness.	Mine impacts same as Alternative 1.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	No change in streamflows. Wilderness Lakes not at any risk.

Table 5-1. Comparison of alternatives by significant environmental issue (cont'd).

ISSUE	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	ALTERNATIVE 7
Wildlife							
Wildlife population and habitat	Temporary disturbance of 1,225 acres (1,169 acres with mine and 199 acres with transmission line). 3.0 miles of new access roads in elk security area associated with transmission line.	Winter closure of Big Hoodoo Mtn. Road for moose. Other mitigation for indirect impacts.	80-acre percolation pond area not disturbed. Wetlands possible water treatment method.	197 acres disturbed by transmission line. 2.4 miles of new access roads in elk security area.	176 acres disturbed by transmission line. 1.6 miles of new access roads in elk security area.	182 acres disturbed by transmission line. No new access roads in elk security area.	No wildlife habitat affected.
Threatened or endangered species Impacts	Loss of 1,174 habitat units, temporary displacement of grizzly bears and increased mortality risk.	Impacts the same as Alternative 1.	Mine impacts same as Alternative 1.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	No significant impact from transmission line construction and operation.	Implementation of grizzly bear recovery plan continued. No other changes.
Proposed mitigation	Noranda would provide a letter of credit, trust fund, bond or similar financial instrument to guarantee periodic payments as necessary to ensure plan implementation. Replacement of habitat loss primarily through KNF implementation of road closures (7.6 miles more than the KNF would close to comply with KNF Forest Plan); Habitat not compensated by road closures replaced by acquiring conservation easements on suitable private land over an 11-year period and then administration of easements over life of project. Salaries of two wildlife professionals funded for increased law enforcement and information and education (I&E) to reduce mortality rate. I&E funded for first 5 years; equivalent funding thereafter for activities approved by a management committee.	A trust fund would be established to fund mitigation Replacement of habitat through suitable habitat acquisition (~4,700 acres) by agencies or trustees over four-year period. Salaries of two wildlife professionals funded for life of project for increased law enforcement and I&E. Other mitigation measures, such as bear-proof garbage containers and removal of road kills, would reduce human/grizzly bear contact.	Mitigation under Alternative 2 implemented.	Mitigation under Alternative 2 implemented.	Mitigation under Alternative 2 implemented.	Mitigation under Alternative 2 implemented.	

Table 5-1. Comparison of alternatives by significant environmental issue (cont'd).

ISSUE	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	ALTERNATIVE 7
Socioeconomics							
Employment	450 new jobs created directly by project and 200 indirect jobs during operation. Construction phase employment slightly higher.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	No new jobs created. Existing high unemployment levels remain.
Population	Increase of 319 people for project life, less than 2 percent increase in Lincoln County. Peak increase of 411 people during construction phase.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	No project-related population increase.
Income	$13.8 million in annual personal income during operation.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	No increase in personal income from project.
Housing	115 housing units needed during construction; 90 housing units needed throughout project. Existing housing supply limited and some new housing development expected.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	No new housing development. Existing housing adequate for current growth.
Community services	Increased need for law enforcement personnel and teachers.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	No increased demand for community services.
Fiscal	Revenues allocated to local government units by Noranda would pay for increased costs through Impact Plan process.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Impacts same as Alternative 1.	Increased revenues and costs to governmental units would not occur.
Location and siting of tailings impoundment	The tailings embankment would remain stable even in the event of a maximum credible earthquake. Artesian conditions at the impoundment site would be controlled using a passive system of pressure relief wells or slot drains. Little Cherry Creek diverted around 595-acre tailings impoundment facility.	Mining impacts same as Alternative 1. Detailing monitoring plan implemented.	Mining impacts same as Alternative 1.	Mining impacts same as Alternative 1.	Mining impacts same as Alternative 1.	Mining impacts same as Alternative 1.	No project facilities constructed.

Table 5-2. Preferred transmission line route criteria.

Criteria	Comment
The use of public lands for location of the facility was evaluated and public lands were selected wherever their use is as economically practicable as the use of private lands and compatible with environmental factors.	Criteria generally favors locations on public lands if economically practicable and compatible with 75-20-503 MCA which lists environmental factors to be considered where applicable to a transmission line. These environmental factors are analyzed in Chapter 4 of the EIS. The BNRC must balance various factors and select the route that minimizes impacts.
Located where there is the greatest potential for general local acceptance of the facility.	Additional information about the general acceptance of the proposed routes is being sought through the draft EIS.
Located to use or closely parallel utility or transportation corridors.	This criterion applies to highways and transmission lines larger than 50-kV. Criterion generally favors locations that use or share existing right-of-ways. Use of U.S. 2 right-of-way was not considered in detail by the agencies due to the proximity of the Fisher River and residences. No utility corridors cross the main project area.
Allows for selection of a centerline in nonresidential areas.	Residential areas generally are areas of platted subdivisions with 5 or more residences per 20 acres.
Located on rangeland rather than cropland and on non-irrigated or flood-irrigated land rather than mechanically irrigated land.	Criterion relates to locations that provide for safe operation of mechanical irrigation equipment.
Located in logged areas rather than undisturbed forest, in timbered areas.	Criterion favors location in clearcut areas.
Located in geologically stable areas with non-erosive soils in flat or gently rolling terrain.	This criterion favors locations on gently rolling terrain with non-erosive soils.
Located in roaded areas where existing roads can be used for access to the facility during construction and maintenance.	Criterion generally favor locations along or within 1/4 mile of a road.
Located where the facility will create the least visual impact.	Considers visual impacts over length of the route.
Located a safe distance from residences and other areas of human concentration.	Considers short- and long-term safety of humans at work, home, and play.
Located in accordance with applicable local, state, or federal management plans when public lands are crossed.	Criterion favors routes that would best meet management objectives of the KNF Forest Plan (1987).

Source: Rule 36.7.2531 (1) of Administrative Rules of Montana, and
Section 75-20-301 (2)(i) of Montana Codes Annotated.

Table 5-3. Compliance of the transmission line routes with adopted route criteria.

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	COMMENTS
Best use of public lands.	9.3 miles public lands; 7.0 miles Champion (57% public)	9.4 miles public lands; 7.0 miles Champion (57% public)	8.9 miles public lands; 7.0 miles Champion (56% public)	10.9 miles public lands; 5.8 miles Champion; 0.4 miles other private (64% public)	All routes have moderate level of compliance with this criterion.
Greatest potential for local acceptance.	Visual concerns for residences along U.S. 2. Other areas of concern not known.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1. Visual and land use concerns at Fisher River crossing. Other areas of concern not known.	Extent of general public acceptance along alternatives not fully known.
Use or closely parallel U.S. 2 right-of-way.	One crossing of U.S. 2.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	All alternatives have low level of conformity to this criterion.
Allow centerline selection in non-residential areas.	No developed residential areas crossed. Individual residences nearby.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	All routes would allow a centerline to be located in undeveloped rural area.
Flood irrigation rather than mechanical irrigation.	None crossed.	Same as Alternative 1.	Same as Alternative 1.	0.2 miles of flood irrigation along Fisher River.	All alternatives avoid mechanically irrigated cropland.
Logged areas rather than undisturbed forest.	Crosses 2.9 miles of harvested timber; 13.4 miles forested.	Crosses 2.8 miles of harvested timber; 13.6 miles forested.	Crosses 3.6 miles of harvested timber; 12.1 miles forested.	Crosses 5.0 miles of harvested timber; 12.1 miles forested.	Alternatives have low to moderate conformity to this criterion.
Geologically stable areas in non-erosive soils on flat or rolling terrain.	About 10% of route attains balance sought by this criterion.	Same as Alternative 1.	Same as Alternative 1.	About 5 percent of route attains balance sought by this criterion.	Study area includes gently sloping valley floors with erodible soils and steep mountainous terrain. This study area makes it difficult for a route location attain an optimum balance of this criterion.

Table 5-3. Compliance of the transmission line routes with adopted route criteria.

CRITERIA	ALTERNATIVE 1	ALTERNATIVE 4	ALTERNATIVE 5	ALTERNATIVE 6	COMMENTS
Uses existing road for access.	0.6 miles of route more than 1/4 mile from existing roads. Estimated 16.1 miles of new access required.	Similar to 1 except that estimated 7.2 miles of new road required.	2 miles of new access required. 0.5 miles of route are more than 1/4 mile from existing roads. Estimated 5.8 miles of new road.	All of 17.1-mile route within 1/4 mile of existing roads. Estimated 5.6 miles of new road required.	All routes make good use of existing roads. Criterion would slightly favor Alternative 6 over Alternatives 4 and 5.
Avoid structures on 100-year floodplain.	Three structures on relatively stable area of Fisher River floodplain.	Same as Alternative 1.	Same as Alternative 1.	Six structures on floodplain of Fisher River where there is evidence of recent channel movement.	A crossing of the Fisher River floodplain cannot be avoided.
Where facility would have least visual impact.	1.7 miles of high; 5.3 miles of moderate; 6.8 miles of low; 2.5 miles of very low impacts.	1.5 miles of high; 5.2 miles of moderate; 7.2 miles of low; 2.5 miles of very low impacts.	1.5 miles of high; 2.7 miles of moderate; 7.9 miles of low; 2.5 miles of very low impacts.	1.7 miles of high; 4.6 miles of moderate; 4.3 miles of low; 6.6 miles of very low impacts.	Due to more miles of very low impact, Alternative 6 has least overall visual impact.
Facility located a safe distance from residences and other areas of human concentrations.	Yes	Yes	Yes	Yes	All routes provide for a location that is safe for people and human activity.
In accordance with KNF Forest Plan (1987).	6 miles of route conflict with management area direction in plan.	5.9 miles of route conflict with management area direction in plan.	3.6 miles of route may conflict with management area direction in plan.	3.9 miles of route conflict with management area direction in plan.	Alternatives 4 and 5 best meet current direction of KNF Forest Plan. All routes require change to some individual management areas.

6

METHODS

THE analysis in this EIS has involved the evaluation of a great deal of information on the land, resources, and people of the project area. Under the requirements of the Montana Metal Mine Reclamation Act, the Montana Major Facility Siting Act and the U.S. Forest Service's mineral regulations (36 CFR 228), Noranda was required to collect sufficient information to allow an evaluation of the environmental impacts of the proposed project. In cooperation with the agencies, Noranda developed study methods, described in detail in a Plan of Study, for the various environmental resources (Noranda Minerals Corp., 1988a). The methods used by Noranda in the collection of baseline information are summarized in the Baseline Data Collection section. Environmental baseline information collected by Noranda is contained in their various applications and is available for public review at agency offices.

The agencies are responsible for the analysis of the environmental baseline information and the assessment of impacts described in Chapter 4. In some instances, such as evaluation of dam stability or assessment of ground water impacts, Noranda prepared an analysis which was subsequently reviewed by the agencies. The methods of analysis for the various resources are described in the Impact Assessment section.

BASELINE DATA COLLECTION

Meteorology and Climate

Meteorological monitoring was conducted at two sites—the proposed tailings impoundment area (referred to as the Little Cherry Creek site) and the proposed plant site (referred to as the Ramsey Creek site). The Montana Air Quality Bureau approved the selection of these two monitoring sites. Wind speed, wind direction, temperature, and stability class were recorded at both sites. At the Little Cherry Creek site, precipitation, relative humidity, solar radiation, and evaporation were also recorded. Published climatological information used to describe the area's

climate came from the National Oceanic and Atmospheric Administration, the National Weather Service, and the Soil Conservation Service.

Air Quality

Data collection for the plant site was begun by U.S. Borax in the spring of 1988 and continued by Noranda. Meteorological and air quality monitoring equipment were co-located at Ramsey Creek and Little Cherry Creek. Measurements at the Ramsey Creek site included—

- PM-10 [particulate matter less than 10 micrometers (μm) in diameter];
- wind speed;
- wind direction; and
- temperature.

Two PM-10 high-volume samplers were located about 6 feet apart on top of a shelter with the sampler inlets 8 feet above the ground. The wind sensors and a temperature device were located on a 10-meter (33-foot) tower. The wind sensors were mounted at the top of the tower and the temperature sensor at the 4-meter level. It was not possible to locate the temperature device any lower because of the potential for burial during snow storms.

The types and configuration of monitoring equipment at the Little Cherry Creek site were similar to the Ramsey Creek site. In addition, relative humidity and solar radiation were measured using devices located 9 meters from the ground. Measurements at the Little Cherry Creek site included—

- PM-10;
- total suspended particulates (TSP);
- wind speed;
- wind direction;
- temperature;
- relative humidity;
- solar radiation; and
- precipitation.

Information gathered during the monitoring period of July 1, 1988 through June 30, 1989 at these two locations was compiled and reported as—

- monthly and annual temperature means;
- temperature extremes;
- wind speed and wind direction frequency distributions;
- atmospheric stability classifications, using sigma-theta values and the methodology outlined in Woodward-Clyde Consultants, Inc., 1989a;
- monthly and annual precipitation means;
- monthly and annual relative humidity means; and
- annual evaporation value (using wind speed, temperature, relative humidity and solar radiation).

Geology/Geotechnical

Geologic investigation of the mine area was conducted by U.S. Borax prior to Noranda's involvement with the project. A total of 29 core holes were drilled from nine separate sites within the known deposit area between 1983 and 1987. Depths of the borings ranged from a few hundred feet to more than 4,500 feet. Geologic information obtained from the drilling program was used to determine structure and stratigraphy of the ore body. Samples were collected for geochemical and mineralogical evaluations. Samples of the ore, barren zone material and tailings generated in a bench-scale test were analyzed for acid-base potential to determine if the materials would be acid generating. Surficial geologic mapping also was conducted.

Geotechnical investigations were conducted by Morrison-Knudsen Engineers, Inc. in 1988 and 1989. The purpose of these investigations was to gather information necessary to evaluate alternative locations for the plant, mine adits, evaluation adits, and the tailings impoundment. Several sites were investigated including—

- plant site and mine adit sites—Ramsey Creek and Libby Creek;

- evaluation adit sites—the Heidelberg Tunnel, the south end of Rock Lake, and the Upper Heidelberg Road; and
- tailings impoundments sites—Little Cherry Creek, Poorman Creek and Midas Creek.

Mapping from aerial photography was conducted to identify landslides and avalanche chutes. Following Noranda's selection of Little Cherry Creek as the preferred tailings impoundment site, more detailed investigations were undertaken. Field investigations consisted of geologic mapping, seismic surveys, drilling, and test pit evaluation. Soil samples from borings and test pits were collected for geotechnical analysis. Field permeability tests were conducted during drilling. Monitoring wells were completed in selected borings. The results of the investigations were used to describe the geologic setting, seismicity (including seismic design criteria), other geologic hazards, and subsurface site conditions (including depth to bedrock and depth to ground water).

The tailings impoundment was sized to completely contain run-off resulting from a 24-hour general storm probable maximum precipitation (PMP) plus snowmelt. The PMP is defined theoretically as the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a certain time of the year. The 24-hour general storm PMP plus snowmelt for the Little Cherry Creek watershed utilized for design has a total precipitation depth of 15.8 inches (Noranda Minerals Corp., 1989a).

Since all runoff upstream of the proposed diversion dam would be routed around the tailings impoundment via the diversion channel, only the tailings impoundment drainage area (which includes the impoundment area) was used to estimate the required inflow volume for containment (Morrison-Knudsen Engineers, Inc., 1989c). The tailings dam would be incrementally raised to maintain the storage capacity necessary for storage of the design storm. An additional freeboard of 3 feet would be maintained above the peak flood water surface associated with the design storm. The agencies reviewed and analyzed the design calculations prepared for Noranda for accuracy and consistency.

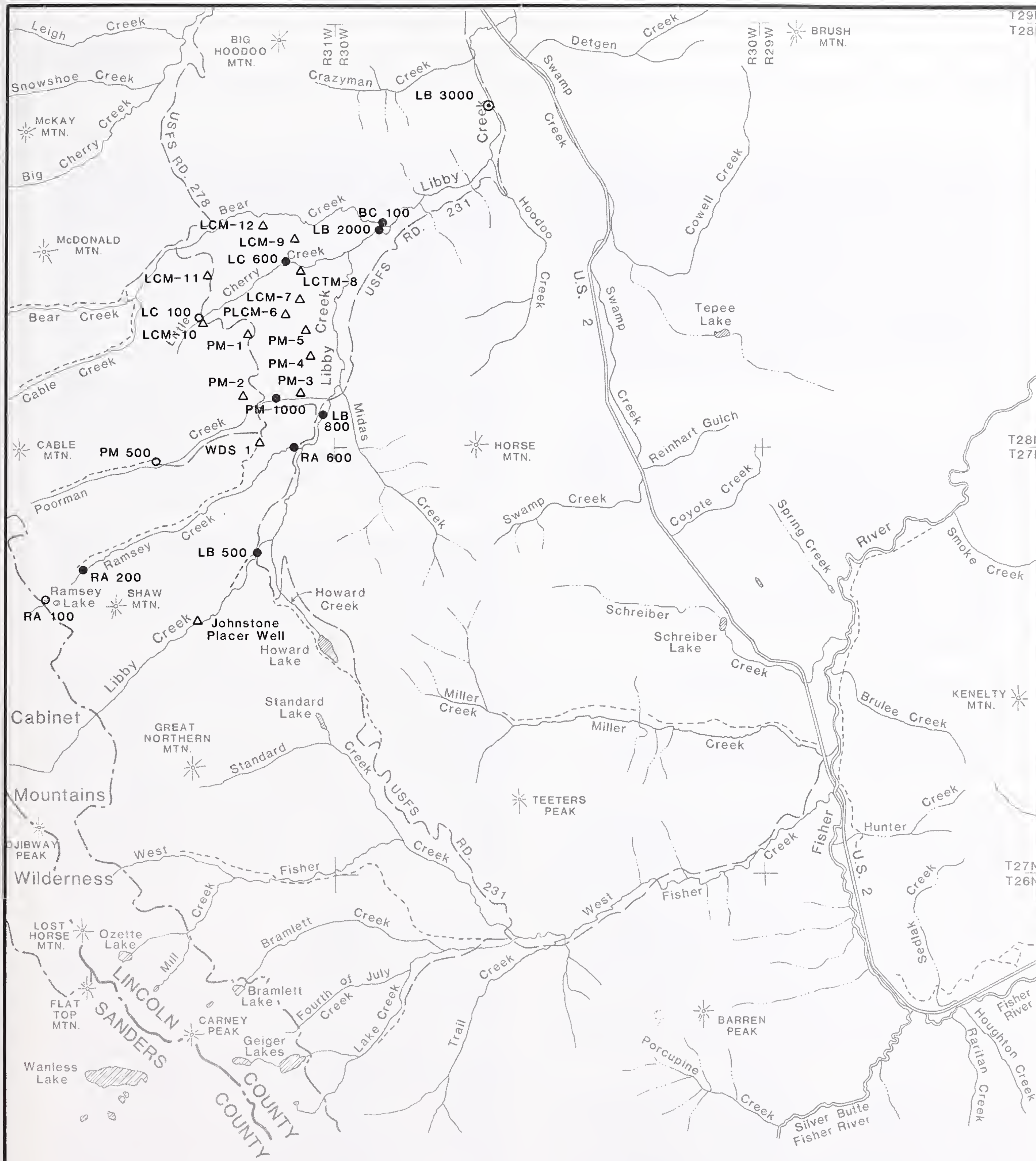
Hydrology

Hydrologic baseline investigations in the project area were initiated by U.S. Borax and completed by Noranda. U.S. Borax conducted its own surface water quality sampling program on the Rock Creek drainage beginning in June, 1986, and on the Libby Creek drainage in September, 1987. A more comprehensive hydrologic baseline investigation plan was developed by U.S. Borax and Chen-Northern, Inc., and approved by the DSL and the KNF. Additional hydrologic investigations began in April, 1988.

Surface water investigations included flood plain mapping, streamflow measurements, and water quality sampling. Flow measurements were made by Chen-Northern, Inc. at 21 sites between April and October, 1988, and at eight sites for the winter program between November, 1988 and April, 1989 (Figure 6-1). A permanent stream gaging station, equipped with a continuous flow recorder and ISCO water sampler to collect daily suspended sediment samples, was constructed on Libby Creek downstream of the project area.

Surface water samples were collected along with streamflow measurements. These samples were analyzed for major and minor ions, nutrients, metals, and sediment. Specific conductance, pH, and temperature were measured in the field during sampling.

Ground water investigations included an inventory of wells, springs, and adits during the summer of 1988. A geophysical reconnaissance (electrical resistivity method) of the tailings impoundment area was conducted to determine depth to water and the configuration of the bedrock surface. Eight monitoring wells (one well is a dual-completion well for monitoring at two depths) were completed in the tailings impoundment area.



Source: Chen-Northern, Inc. 1989.

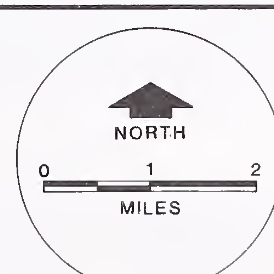
LEGEND

Surface Water Sampling Sites

- ● Staff/Crest Gages
- ○ No Gages
- ⊙ Continuous Recorder
- △ Monitoring Well

FIGURE 6-1.

BASELINE HYDROLOGIC MONITORING LOCATIONS



Static water levels were measured in the wells in August and October, 1988, and in January and March, 1989. Ground water quality samples were collected at the same time. Samples were analyzed for concentrations of total recoverable metals. Measurements of pH, specific conductance, water temperature, and redox potential were made in the field. Aquifer tests were performed on all wells to determine the hydraulic permeability and transmissivity of the aquifer.

Estimates of adit water inflow by Chen-Northern, Inc. (Noranda Minerals Corp., 1989b) were reviewed by the agencies. Inflow estimates were calculated using the following equation—

$$Q_O = \frac{2\pi\ K\ H}{2.3 \log (2H/R)} \times 7.48$$

Where—

Q_O is the ground water inflow per unit length of tunnel (gpm/ft.),

K is the hydraulic conductivity (ft./min),

R is the tunnel radius (ft.), and

H is the hydraulic head measured as the vertical distance from the adit to the overlying water table.

Hydraulic conductivity values were obtained from bedrock aquifer tests conducted at the site of the proposed ASARCO tailings pond at the confluence of Rock Creek and the Clark Fork River, (Noranda Minerals Corp., 1989b). Hydraulic conductivities ranged from 7.8×10^{-5} cm/s to 3×10^{-6} cm/s, and had an average value of 2.35×10^{-5} cm/s. Since fracture porosity and permeability decrease with depth, the hydraulic conductivity was decreased one order of magnitude for each 1,000 feet below ground surface.

The hydraulic head was determined from the depth below the regional water table. The exploration holes in the Rock Lake area encountered stable water conditions at a depth of 500 feet below ground surface (Noranda Minerals Corp., 1989b). This depth corresponds to an elevation of 5,400 to 5,500 feet, which is assumed to be the regional water table.

Ground water inflow to the Libby Creek adit and the Ramsey Creek adits was calculated on a segment by segment basis (Table 6-1). Except for the initial segment, each segment was 2,000 feet long. The Libby Creek adit was assumed to be 16,800 feet long, to have an 8-foot radius, and to have portal elevation of 4,010 feet. The Libby Creek adit would be essentially horizontal. The Ramsey Creek adits were assumed to be 13,000 feet, to have a radius of 30 feet, and to have a portal elevation of about 1,000 feet below the Libby Creek adit. Because adit radius occurs in a logarithmic term in the tunnel inflow equation, the adit size does not have a large effect on the inflow estimate.

Total estimated inflows into the adits are 392 gpm (202 gpm from the Libby Creek adit and 190 gpm from the Ramsey Creek adit). The majority of the inflow comes from the segment nearest the surface, and decreases significantly with depth.

In addition to the adits, inflows may result from other sources including inflow into deep mine workings, additional drifting not estimated, and inflows from individual geological structures (Noranda Minerals Corp., 1989b). Inflows from these sources were estimated to contribute an additional 560 gpm. Calculations by the agencies using the adit inflow formula concurred with Noranda's estimate.

Aquatic Life and Fisheries

Physical habitat characteristics were analyzed for 24 reaches in five project area streams—Little Cherry Creek, Poorman Creek, Bear Creek, Ramsey Creek and Libby Creek. Macroinvertebrates (aquatic insects) populations were sampled three times from 18 reaches between August, 1988 and April, 1989.

Physical habitat features at the 24 stream reaches within the project area were classified using a generalized geomorphic approach agreed to in the field with agency personnel. Results from August, 1988 stream surveys were analyzed using the Forest Service's General Aquatic Wildlife System (U.S. Forest

Service, 1985) "level 3 assessment" to determine Riparian Habitat Condition, Habitat Vulnerability Index, and Habitat Condition Index values for each stream reach. Also, percent available spawning and rearing areas were determined for each reach.

Macroinvertebrates were collected using a fine mesh Hess sampler from 17 stations in the Libby Creek drainage during August and October, 1988 and April, 1989. Samples were analyzed to determine total population density and biomass, number of taxa (richness), Shannon diversity, biotic index, plus several other community measures based on numbers and kinds of benthic macroinvertebrates at each site on each sampling date.

To determine possible fall spawning activities in Libby Creek, 26.1 miles of stream upstream from its confluence with the Kootenai River were surveyed during late September and October, 1989. Personnel from the Montana Department of Fish, Wildlife, and Parks (DFWP) sampled fish populations in Libby, Ramsey, Poorman, and Little Cherry creeks during August and September, 1988. Two and three-pass electro-shocking techniques were used. The results of these sampling surveys are presented in Noranda's permit application (Western Resources Development Corp., 1989a).

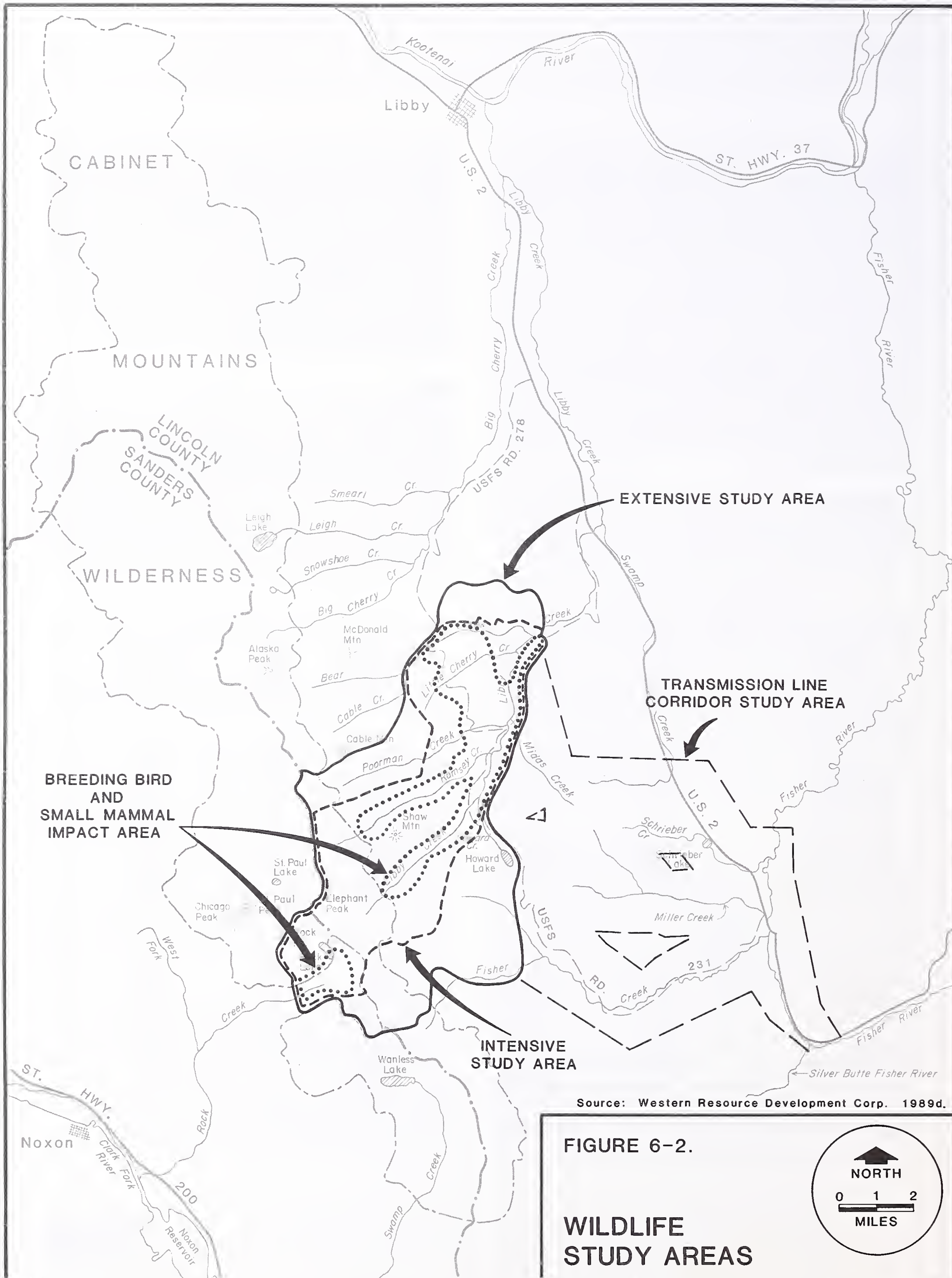
Wildlife

The wildlife study area comprises three increasingly larger areas—a 12.1-square-mile area, which included all potential mine development areas, a 30.8-square-mile intensive study area, and a 49.2-square-mile extensive study area (Figure 6-2). Wildlife use of the transmission line corridor area was assessed during two helicopter flights and four vehicle

Table 6-1. Adit inflow calculations.

Adit Segment (ft.)	No. (ft.)	Adit level K (ft./min.)	Calculated average Q_o (gpm/ft.)	Segment inflow (gpm)	Cumulative inflow (gpm)
Libby Adit (r=8 ft.)					
0-2,800	150	3×10^{-5}	0.0584	164	164
2,800-4,800	350	3×10^{-6}	0.0110	22	186
4,800-6,800	750	5×10^{-7}	0.0034	7	193
6,800-8,800	1,250	1×10^{-7}	0.0010	2	195
8,800-10,800	1,600	7×10^{-8}	0.0009	2	197
10,800-12,800	1,800	6×10^{-8}	0.0008	2	199
12,800-14,800	2,050	3×10^{-8}	0.0005	1	200
14,800-16,800	1,650	6×10^{-8}	0.0008	2	202
Ramsey Creek Adits (r=30 ft.)					
0-1,000	150	5×10^{-5}	0.1532	153	153
1,000-3,000	350	3×10^{-6}	0.0157	31	184
3,000-5,000	1,100	1×10^{-7}	0.0012	2	186
5,000-7,000	1,900	3×10^{-8}	0.0006	1	187
7,000-9,000	2,550	8×10^{-9}	0.0002	1	188
9,000-11,000	2,600	1×10^{-8}	0.0002	1	189
11,000-13,000	2,400	3×10^{-8}	0.0007	1	190

Source: Noranda Minerals Corp. 1989b. Attachment 2.



Source: Western Resource Development Corp. 1989d.

FIGURE 6-2.

WILDLIFE STUDY AREAS

surveys conducted between April and July, 1989. Additional information was obtained from the DFWP and the KNF. All small mammal and bird sample plots were within the potential development area, while big game studies were conducted in the extensive study area. Big game distribution, relative abundance and seasonal habitat use were determined by—

- systematic helicopter surveys;
- vehicle surveys;
- ground (pedestrian) surveys, including track counts;
- qualitative observations;
- literature review; and
- discussions with local DFWP and USFS biologists.

Breeding birds and small mammals were sampled on permanent plots in six major habitat types—riparian, western hemlock, mixed conifer, clearcut, shrubfield, and spruce fir. Breeding birds were sampled using strip transect methods and small mammals by trapping. Raptors, waterfowl and shorebirds were sampled in conjunction with the breeding bird surveys and other field work. Separate harlequin ducks surveys were conducted along suitable creeks.

No specific field surveys were conducted for species listed as endangered or threatened by the U.S. Fish and Wildlife Service (USFWS). Recent studies performed in the project area and data collected in conjunction with the other wildlife surveys were used as information sources. Use of the area by species of special concern was determined from data collected during other field work, recent reports, species habitat affinities, and distribution of suitable habitats. Species of special concern include species listed as threatened, endangered, or sensitive by the USFWS, the MDFWP, or the KNF.

Special surveys were conducted for harlequin duck, Couer d'Alene salamander and boreal owl. The upper reaches of Libby and Ramsey creeks were surveyed for harlequin duck in mid-June, 1988. Boreal owl surveys were conducted by listening for and soliciting boreal owl calls during the peak of the calling season. Although 15 nights were spent in the field, weather conditions prevented these surveys from being really effective. Surveys were conducted of suitable Couer d'Alene salamander habitat along the Libby Creek and Bear Creek roads in September, 1989.

Soils

Noranda collected soils information at three levels of detail, depending on the anticipated level of disturbance. The three areas are the extensive study area, the transmission line corridor area, and the intensive study area. The intensive study area encompassed all mine areas proposed for disturbance.

The KNF Land System Inventory (Kuenan and Gerhardt, 1984), a mapping system that integrates soils and vegetation information, was the primary information source for the extensive study area and transmission line corridor area. Additional field investigations were also conducted for the corridors.

A detailed soil survey was conducted on about 2,300 acres, including all areas proposed for mine-related disturbance. Detailed soil surveys were designed to determine the location and extent of the major soils and to serve as guidelines in predicting the availability, quantity, and quality of soil materials suitable for salvage and reclamation use.

Surveys were conducted according to standard procedures employed by the USDA Soil Conservation Service and current DSL guidelines. Characteristics such as parent material, soil textures, and rock fragment content were used to distinguish soil types. Additional properties, such as slope steepness, surface soil textures, and the pattern of soils types on the landscape, were used to distinguish mapping units. Soils were identified and mapped on topographic maps and aerial photos at a scale of 1:4,800 (1 inch = 400 feet).

Soil profiles were examined by excavating pits. Each soil profile was described in detail to 60 inches in depth unless bedrock or unsuitable salvage material was encountered first. Samples were collected from each major horizon (layer of soil) and analyzed by an independent laboratory.

Vegetation

The vegetation of the project area was mapped according to vegetation structure and species dominance. Quantitative information was collected on the vegetation of the mine area and qualitative vegetation information was procured for the transmission line corridors. Measurements included—

- vegetation cover;
- tree density, reproduction, diameter, basal area, volume and age;
- shrub density; and
- herbaceous production.

A point-intercept method was used for cover sampling and quadrat methods for density and herbaceous production. Sample sites were located in representative areas.

Vegetation in the transmission line corridor area was mapped using aerial photographs combined with field reconnaissance. Vegetation types were delineated according to the relative density of dominant overstory and/or understory woody species.

Land Use

Land use inventory information from the KNF, the DSL, and Lincoln County was used to describe baseline conditions.

Visual Resources

An inventory of visual resources was compiled from existing data available from the KNF. The visual resource inventory conducted by the KNF is known as the Visual Management System (VMS). The VMS included inventories of variety classes, sensitivity levels for travel routes, Visual Quality Objectives, and Visual Absorption Capability.

Sensitivity Levels classify the level of people's concern for the scenic quality of an area. Primary travel routes and use areas are classified as Level 1, highest sensitivity. Areas with a very low volume of users are classified Level 3, lowest sensitivity, and Level 2 sensitivity describes a moderate level. Visual analysis typically classifies views into foreground (up to 0.5 mile), middleground (0.5 to 3 miles), and distant or background views (over 3 miles). The dominance of visual changes to the landscape generally depends on how close the viewer is to the changes. View duration is also an important consideration. The primary use areas, such as destination peaks, and campgrounds, will typically have a longer view duration than primary travel routes.

KNF's objectives for the visual management of the land are expressed as Visual Quality Objectives (VQO) which indicate the level of the public's concern for visual quality. The "preservation" VQO prohibits any modification to the landscape, whereas "maximum modification" allows development to dominate over the characteristic landscape, if necessary. "Retention," "partial retention" and "modification" are VQOs that cover the range between these extremes.

Visual Absorption Capability (VAC) determines the amount of modification or change a site can absorb before the visual character is adversely affected. Many environmental and physical elements are factored into the analysis, such as vegetation, land form diversity, aspect relative to viewer, slope, aspect relative to sun/shade potential, soil productivity, soil color, and soil stability. High VAC refers to sites that can accept a significant amount of visual change, such as broad areas with little topographic relief. Low VAC refers to the sensitive areas affected by small amounts of visual change.

For the proposed transmission line, visibility was evaluated for 18 observation points scattered throughout the project area. These points were in the

wilderness, at recreation sites, on trails, and along the U.S. 2 corridor. This information was integrated with the visual inventory to assess impacts.

Four visual impact levels—high, moderate, low and very low—were determined at various sites by identifying and combining the level of contrast between the proposed transmission line and the landscape, considering the ability of the landscape to absorb transmission line related changes, and the scenic quality of the areas.

Transportation

Noranda collected information on the existing transportation system from published reports of the Montana Department of Highways and the U.S. Forest Service, and from personal communications with officials of the Montana Department of Highways, Lincoln County, and the KNF.

Socioeconomics

Historic and current socioeconomic information was collected and organized to follow DSL's *Plan of Operating Guidelines*. Because preferred route access to the mine has not yet been finalized, information was collected for both Lincoln and Sanders counties. Primary categories of information included—

- social;
- cultural;
- population;
- housing;
- human health and safety;
- community and personal income;
- employment;
- tax base;
- demand on governmental services;
- industrial and commercial services; and
- environmental plans and goals.

Information was collected throughout 1988. Information sources included federal, state and local government agencies. Interviews with local officials and citizens also were conducted to determine key issues and concerns. Population projections through the Year 2010 were developed using a demographic/economic simulation model.

Cultural Resources

Cultural resources were assessed through a literature review and file search, and an intensive pedestrian survey of 3,587 acres of KNF, state and private lands which may be affected by the proposed project. Portions of the proposed access roads and transmission line corridors were included in the survey. Sections that crossed private lands were not examined during initial field work. These areas would be intensively inventoried for cultural resources once final road and transmission line corridors have been selected and access obtained to private lands.

The literature and records review included—

- examination of previous cultural resource reports for the project area, General Land Office (GLO) plats, mineral resource surveys, historic maps (such as land status maps) and site files at the Kootenai National Forest Supervisor's Office
- a check of the National Register of Historic Places (NRHP); and
- a search of the Montana Statewide Cultural Resource site files at the State Historic Preservation Office (SHPO).

Sound

Ambient noise levels were measured in September, 1988 near the two meteorological monitoring stations. The sampling program consisted of collecting 0.5-hour averages of A-weighted equivalent sound levels and calculating statistical properties of the noise data. In addition, an octave filter was used to collect instantaneous A-weighted sound levels at ten frequency bands. Ambient noise

data were collected during daytime and nighttime hours for a weekday and weekend period.

IMPACT ASSESSMENT

Air Quality

As part of Noranda's air permit application, Noranda completed air quality computer modeling to predict impacts. Air quality impacts were estimated using EPA's COMPLEX I and Industrial Source Complex (ISC) computer models. Visibility impacts were determined using standard EPA screening analyses for Level I and Level II procedures. These procedures are described in the following sections.

Modeling. Computer simulation of the transport and dispersion of air pollutants is the principal approach to evaluating the project's impact on air quality. Among the many computer models created for this purpose, the EPA has approved several for use as prescribed in its *Guideline on Air Quality Modeling* (EPA, 1986). Using approved models, the impacts of emissions of particulate matter, nitrogen dioxide, carbon monoxide, and lead were predicted using information available from the air quality permit application of Noranda (TRC Environmental Consultants, Inc. 1989). In addition, impacts of heavy metals—arsenic, antimony, cadmium, chromium, zinc, copper, and iron—were estimated on the basis of their observed presence in samples of airborne particulates.

The two proposed mine adits would be point sources, and lie in rough terrain; EPA's COMPLEX I model was used for these sources. The vicinity of the proposed tailings impoundment is much flatter, and has less need for a model that can account for the effects of complex terrain. Moreover, the tailings impoundment would be an area source, a type which cannot be modeled with COMPLEX I. The model used for the tailings impoundment was ISCST, which is approved by EPA for area sources.

Modeling assumptions. For any model, it is necessary to adopt a set of assumptions regarding meteorological variables put into the model. With the exception of wind speed and precipitation at Little Cherry Creek, meteorological data collected at the proposed project site during the period of July 1, 1988 through June 30, 1989 are assumed to represent normal weather conditions. Data used in the modeling were checked the agencies by comparing the information collected with other recorded air quality and meteorology values (i.e. Rock Creek and the town of Libby). All information was consistent with established baseline conditions in the region. The precipitation and wind speed information at Little Cherry Creek may be anomalous. Worst case assumptions were made in computing emission factors and dispersion for the tailings pond to compensate for this apparent anomaly.

Background pollutant concentrations are needed to determine the air quality resulting from the proposed project's modeled impacts. The background values used were obtained from baseline monitoring at the project site. For nitrogen dioxide and ozone, the background values were taken from data collected by the Montana Power Company near Great Falls, Montana (TRC Environmental Consultants, Inc. 1989).

The Ramsey Creek and Libby Creek sites are so similar that data collected at Ramsey Creek were used to represent both locations. Data for modeling the Little Cherry Creek site were collected there because the surrounding terrain is not similar to the Ramsey Creek and Libby Creek sites. The ISCST model was used to predict particulate impacts from the tailings pond in the Little Cherry Creek drainage. Because ISCST is a "flat terrain" model (pollutant sources lower in elevation than the surrounding terrain cannot be modeled), it was assumed that the surrounding terrain is at the same elevation as the tailings pond.

Emission estimates. Emission estimates used in impact modeling were derived from the EPA AP-42 handbook, *Compilation of Air Pollutant Emission Factors* (EPA, 1985). In some cases, standard emission factors were supplemented with project

design information (TRC Environmental Consultants, Inc., 1989). The actual emissions from the proposed project would depend on the level of activity. The first two years of the project would be taken up in construction. Mining would begin during the second two years. The emission estimates are based on full production of 20,000 tons of ore per day, which is planned to begin in the third year of the mine life. Emissions of air pollutants would occur at four locations—the Ramsey Creek adit, the Libby Creek adit, the Ramsey Creek plant, and the tailings impoundment.

Emissions from the Ramsey Creek adit would originate in the mine. Sources would include primary crushing, coarse ore conveying, and combustion products from blasting, diesel exhaust, and propane air heaters. Two jaw crushers would be used to crush waste rock and ore; their emissions would be controlled with a high-energy wet venturi scrubber. Emissions from other sources would be controlled by a combination of operating and maintenance practices designed to meet worker health protection standards and to reduce the ventilation requirements. Air emissions would be exhausted horizontally from the adit, with an expected flow rate of 700,000 cubic feet per minute.

The plant site would contain facilities for handling and grinding the coarse ore from the mine, and for handling the concentrate produced by the mill. Ore transfer to a coarse ore stockpile, and wind erosion of the stockpile would be sources of fugitive dust emissions. Dust from coarse ore handling would be controlled with a high-energy wet venturi scrubber. No dust emissions are anticipated from the mill as the material in process would be kept wet. Some dust would be emitted from concentrate handling, but the amount would be minimized by maintaining a high moisture content.

Emissions from the Libby Creek adit would consist of combustion products from blasting, diesel exhaust, and propane air heaters. Air emissions from the adit would be exhausted vertically, at an expected flow rate of 700,000 cubic feet per minute. As with similar emissions from the Ramsey Creek adit, these would be controlled by a combination of operating and maintenance practices.

The tailings from the mill, a slurry of finely divided solids, would be gravity-fed to the tailings pond at Little Cherry Creek. Tailings in the pond would be wet, and as water drained from these, part of the surface would dry out and become a source of fugitive dust, mainly in the summer months. Water sprinklers would be used to reduce emissions.

Impact estimates. The air pollutant emissions described above (TRC Environmental Consultants, Inc. 1989), were used to estimate the air quality impacts caused by the project. Although the proposed project is not subject to the federal Prevention of Significant Deterioration regulations, the definition of "significant" (with respect to emission rates) used in those regulations was employed to determine which pollutants to model (Table 6-2). On this basis, particulate matter, nitrogen dioxide and carbon monoxide were modeled for short and long-term impacts. Estimates of heavy metal impacts were based on the observed presence of the metals in samples of airborne particulates.

Table 6-2. Comparison of emission rates with significant levels.

Pollutant	——Emission rate—— (g/sec)	(tpy)	Significant level (tpy)
TSP	0.4780	15.93	25
PM-10	0.3988	13.29	15
NO_x	4.2982	143.27	40
SO_2	0.6599	22.00	40
CO	5.7572	191.90	100
HC	0.2213	7.38	40
Pb	2.84×10^{-5}	0.001	0.6

Source: TRC Environmental Consultants, Inc. 1989. V. 1, p. 4-25.

The particulate emissions modeled are those known as total suspended particulates (TSP). This term is defined by a standard sampling method, but is generally taken to mean airborne particles with a diameter of 30 µm or less. Currently, federal and state regulations are directed at particles of 10 µm or less (PM-10). Because emission factors for PM-10 emissions are generally not available, model results for TSP were compared to standards for PM-10. PM-10 is a subset of TSP; therefore this approach would tend to overestimate the PM-10 impacts. However, it is expected that most of the proposed project's estimated particulate emissions will be in the PM-10 range, so that any overestimate should be small.

Geology/Geotechnical

The mine area was evaluated to determine if surface subsidence might occur as a result of mining. Areas potentially susceptible to subsidence were determined based on the thickness of overburden lying above the deposit compared with the expected mine thickness. Areas with less than a 10-to-1 overburden-to-mine thickness ratio were designated as potentially susceptible to subsidence. This ratio was selected based on information provided in Piggot and Eynon (1977). Isopach maps of the overburden and mineralized zones were prepared based on the approximately 30 core holes drilled into the deposit. An overlay was then prepared to display areas of the deposit that were potentially susceptible to surface subsidence.

The proposed tailings embankment in Little Cherry Creek was analyzed for both static and pseudostatic (seismic) stability using the computer program STABL (Siegel, 1975). Conservative soil strength parameters were used in the stability analyses to represent the various materials which comprise the embankment, including the dam earthfill and rock fill, foundation soils, cycloned sand tailings, and impounded pond tailings.

The stability of the upstream and downstream slopes of the starter dam were analyzed for the end-of-construction condition prior to tailings deposition. The stability of the downstream slopes of both the starter dam and the impoundment dams at the end of the project were analyzed for both steady-state seepage and seismic loading, using a conservatively high free water surface within the dam (Noranda Minerals Corp., 1989a). Minimum acceptable factors of safety for the various analyses were selected in accordance with recommendations of the U.S. Army Corps of Engineers (1970). A seismic coefficient of 0.1 g was utilized for the seismic analyses (Noranda Minerals Corp., 1989a). Results of the stability analyses are given in Table 6-3.

Table 6-3. Results of stability analyses.

Loading condition	Embankment stage	Slope	Minimum acceptable factor of safety	Minimum computed factor of safety
End-of-construction	Starter dam	Upstream	1.3	1.41
End-of-construction	Starter dam	Downstream	1.3	1.55-2.02
Steady-state seepage	Starter dam	Downstream	1.5	1.62
Steady-state seepage	Final dam	Downstream	1.5	1.97
Design floor	Final dam	Downstream	1.4	1.65
Seismic	Starter dam	Downstream	1.0	1.23
Seismic	Final dam	Downstream	1.0	1.46

Source: Noranda Minerals Corp. 1989a.

Supplementary static stability analyses of the tailings embankment were independently performed by the agencies. These analyses addressed the potential effect of excess pore pressures due to construction of the downstream raised tailings embankment with cycloned tailings sands. A summary of these analyses, including the major assumptions and factors considered in the analyses, is discussed in the following sections.

The starter dam, with a crest elevation of 3,500 feet, would be sequentially raised in the downstream mode through the use of tailings sands developed from two-stage cycloning of the tailings. The proposed rate of rise is about 50 feet (up to a crest elevation of 3,550 feet) during the first two years of operations, or about 25 feet per year (Morrison-Knudsen Engineers, Inc., 1989b). This is the maximum rate of rise for the embankment, as the rate decreases with increasing time. Maximum excess pore pressures within the cycloned sands and starter dam would be associated with the maximum rate of building; therefore, the dam section chosen for analysis had a crest elevation of 3,550 feet.

The shear strength parameters assigned to the impounded tailings and coarse tailings sands were conservatively assumed based on experience with similar materials and on published summaries of test data for hard rock copper tailings (Vick, 1983; Volpe, 1979; Chen and Van Zyl, 1988). The strength parameters of the compacted earthfill and random rockfill of the starter dam were also conservatively assumed based on experience and published data for similar rockfill (Leps, 1970; Marsal, 1972; Donagne and Cohen, 1978). The strength parameters for the foundation soils were estimated based on the results of the geotechnical investigation completed by Noranda (Morrison-Knudsen Engineers, Inc., 1989a and 1989c). A summary of the strength parameters utilized in the stability analysis is presented in Table 6-4.

For the proposed situation of an embankment constructed in the downstream method and raised at the maximum rate of about 25 feet per year with cycloned sands, it can be safely assumed that the excess pore pressures will dissipate as rapidly as the load is applied (Vick, 1983), and will therefore have no adverse impact on the embankment stability. Excess pore pressures are considered to be critical to the stability of upstream raised embankments raised at the rate of about 50 feet per year or more, especially when relatively fine grained tailings are utilized (Vick, 1983).

A conservative excess pore pressure parameter of 0.2 (times the applied overburden stress) was selected

Table 6-4. Summary of soil shear strength parameters used in embankment stability analysis.

Description	unit weights: wet (pcf)	unit weights: saturated (pcf)	Effective friction angle (degrees)	Effective cohesion (psf)
Starter dam earthfill	124	133	33	0
Cycloned sand tailings	110	123	33	0
Starter dam rockfill	140	145	38	0
Foundation layer 1	125	135	35	0
Foundation layer 2	135	141	35	0
Fine tailings	100	110	0	500

Source: IMS Inc. 1990.

for the cycloned tailings sands and compacted starter dam earthfill. The location of the phreatic (free water) surface was conservatively assumed to be located 10 feet below the crest of the embankment at the embankment centerline, corresponding to the assumed level of impounded fine tailings upstream of the embankment. The location of the phreatic surface within the downstream portion of the embankment was conservatively assumed to be much higher than would be expected within the relatively free-draining cycloned sands.

Shallow and deep-seated circular failure surfaces within the earthfill, tailings and foundation soils were analyzed using the computer program PCSTABL5 (Carpenter, 1985), utilizing the simplified Bishop method. A static stability analysis of the downstream face of the year two tailings embankment was performed. Strength and other geotechnical parameters assumed for the analysis are as discussed in previous paragraphs. The resulting factor of safety from the stability analysis had a value of 1.54.

The computed factor of safety for the static stability analysis of the year two dam exceeds the generally accepted minimum value of 1.5 (U.S. Army Corps of Engineers, 1970). It should be noted that the assumed soil strength parameters and loading conditions (such as the height of the phreatic surface in the embankment) are considered to be very conservative relative to the actual conditions that are anticipated to exist.

Hydrology

The locations of perennial streams were determined from USGS topographic maps. Locations of projected stream crossings for the transmission line without nearby bridges were determined by overlaying known and needed roads on the topographic maps and comparing locations of individual structures and roads to the locations of streams. Where a crossing of a perennial stream would be necessary for construction and maintenance, it was added to a list of stream crossings along each route. Further, the amount of surface disturbance within 200 feet of each perennial stream was tallied.

The agencies evaluated the potential subsidence effects of the mine on the surface water resources in the Cabinet Mountains Wilderness, particularly Libby Lakes, St. Paul Lake and Rock Lake. Effects were estimated based on proximity of mining to the lakes, the amount of overburden separating the mine workings from the lake bottoms, and the potential for intercepting faults beneath and adjacent to the lakes.

Surface water quality. Surface water quality impacts were estimated using a mass balance loading analysis. The analysis was conducted for station LB 800 below the confluence of Ramsey Creek and Libby Creek, and station LB 2000 located on Libby Creek above the confluence with Bear Creek. Station LB 800 is located downgradient (with respect to surface and ground water flow) of the proposed percolation ponds and LB 2000 is located downgradient from the tailings impoundment locations. Seepage from the percolation pond and land application areas and from the tailings impoundment would enter shallow ground water systems which discharge to Libby Creek. The loading analysis assumes complete mixing of streamflow with the other discharges at each station.

The loading analysis was performed to estimate water quality changes under both low and average flow conditions in Libby Creek (Table 6-5). Flows in Libby Creek were projected using a proportional drainage area adjustment of reported flows in Granite Creek (USGS, 1982). Existing water quality is based upon the baseline monitoring included in the permit application (Chen-Northern, Inc., 1989). Average water quality is the average of all samples collected at station LB 800 or LB 2000 during the baseline years. Low flow water quality is based upon samples collected in September, 1988.

Four water discharge scenarios were considered in the Alternative 1 loading analysis—two mine construction scenarios in which adit and mine water would be discharged at different rates in the percolation pond area, the first year of operations in which adit water would be discharged and tailings effluent would seep from the Little Cherry Creek tailings impoundment, and Year 16 of operations when tailings seepage would be at its maximum.

Post-operational discharges from the abandoned mine workings and from the tailings impoundment have not been considered in the loading analysis. Post-operational seepage from the tailings pond would be less than the seepage in Year 16. The quantity and quality of the post-mining discharge from the abandoned mine workings cannot be estimated at this time. Mining inflows would be monitored during operations to estimate the quantity and quality of post-mining discharges. Noranda would be required to mitigate adverse effects that would result from post-mining discharge.

During construction of the adits (Year 1 of construction), ground water would flow into the Libby Creek and Ramsey Creek adits at an estimated rate of 392 gpm. Excess mine water would be discharged in the infiltration system near the Libby Creek adit and in the Ramsey Creek percolation pond/land disposal area. The discharge would enter shallow ground water systems which discharge to Ramsey Creek and Libby Creek above station LB 800 on Libby Creek. The Libby Creek adit is currently under construction, and water quality data are available for inflows into and discharges from the adit (Table 6-6, following page). Data for adit discharge water in the separator was used to estimate water quality changes in the loading analysis. Ammonia concentrations are not available for the adit water, but are expected to be similar to ammonia concentrations in mine water (Table 6-7).

Table 6-5. Stream flow rates used in loading analysis.

	Granite Creek	LB 800	LB 2000
Drainage area (mi²)	23.6	20.8	41.0
Reported 7-day 10-year low flow (cfs)	5.0	—	—
Projected 7-day 10-year low flow (cfs)	—	4.4	8.7
Reported average annual flow (cfs)	70	—	—
Projected average annual flow (cfs)	—	62	122

Source: Noranda Minerals Corp. 1989h.

Table 6-7. Mine water quality.

Parameter	Troy Mine† (mg/L)	Troy Mine§ (mg/L)	Estimated quality (average) (mg/L)
Total dissolved solids	194	205	200
Calcium	—	26	26
Magnesium	—	6	6
Sodium	—	11	11
Potassium	—	3	3
Bicarbonate	—	66	66
Chloride	—	<1	<1
Sulfate	27	32	30
Ammonia	8.5	9.4	9
Nitrate/nitrite	17.3	—	17.3
Aluminum	<0.1	<0.1	<0.1
Arsenic	<0.005	<0.005	<0.005
Cadmium	<0.001	<0.001	<0.001
Chromium	—	—	—
Copper	0.075	0.07	0.073
Iron	—	—	—
Lead	<0.01	<0.01	<0.01
Manganese	0.43	0.55	0.49
Mercury	<0.001	<0.001	<0.001
Molybdenum	—	—	—
Silver	<0.005	<0.005	<0.005
Zinc	0.015	0.02	0.018

Sources: †Noranda Minerals Corp. 1989h and ASARCO, Inc. 1990.
§Noranda Permit Application.
Metals concentrations are dissolved.

During development of the mine workings (Years 2 and 3 of construction), prior to operation of the mill and construction of the Little Cherry Creek tailings impoundment, ground water would also flow into deep mine workings. Inflows into the mine workings have been estimated at 560 gpm (Chen-Northern, Inc., 1989). The expected mine water quality (Table 6-7) is based upon mine water discharged at ASARCO's Troy Mine. The Troy Mine is geologically similar to the proposed Montanore Project. The quality of water from the Troy Mine provides the best available estimate of quality of the water that would be discharged during operations at the Montanore Project.

After the mill has been constructed and operations begin, excess adit and mine water would be used as makeup water in the milling process. During the Year 1 of operations, however, Noranda would discharge a small amount (69 gpm) of excess mine water in the excess water disposal areas. It is anticipated that this excess water would be adit water quality.

Also during the first year of operation, construction of the tailings impoundment would have begun.

Table 6-6. Adit water quality.

Parameter	Inflow Adit wall at 1,775 ft.	Inflow Adit wall at 2,010 ft.	Adit water in separator§	Adit water discharge to percolation pond†
	(mg/L)			
Total dissolved solids	119	100	172	241
Calcium	25	19	14	48
Magnesium	8	8	5	3
Sodium	10	22	12	13
Potassium	<1	<1	24	11
Bicarbonate	123	135	67	121
Chloride	1	4	2	1
Sulfate	10	6	29	29
Ammonia	—	—	—	—
Nitrate/nitrite	0.10	<0.01	9.22	3.02
Aluminum	<0.1	<0.1	0.1	1.4
Arsenic	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.001	<0.001	<0.001	0.0013
Chromium	<0.02	<0.02	<0.02	<0.02
Copper	<0.01	<0.01	<0.01	0.007
Iron	<0.05	<0.05	<0.05	2.79
Lead	<0.01	<0.01	<0.01	0.013
Manganese	0.06	0.03	<0.02	0.06
Mercury	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.05	<0.05	<0.05	<0.05
Silver	<0.001	<0.001	<0.001	0.0002
Zinc	<0.02	<0.02	<0.02	<0.04

Source: Noranda Minerals Corp. 1990.
§Values used in loading analysis
†Metals concentrations in discharged water are total recoverable; other three samples were analyzed for dissolved metals.

Tailings water from the impoundment would seep through the tailings embankment and through the bottom of the impoundment. Seepage through the embankment would be collected and pumped back into the tailings impoundment. Seepage through the embankment, therefore, is not included in the loading analysis.

Seepage from the bottom of the impoundment would enter the underlying aquifer. The seepage rate was estimated as a one-dimensional seepage analysis using the Darcy Equation. A detailed discussion of this analysis is provided in the permit application (Morrison-Knudsen Engineers, Inc. 1989a). The seepage analysis indicates that seepage from the bottom of the impoundment would increase over the project life.

During the first year of operations, the estimated seepage rate from the bottom of the impoundment is 50 gpm. Tailing water quality is expected to be similar to tailings water of the Troy Mine (Table 6-8). Seepage from the bottom of the impoundment would enter shallow ground water which discharges to Libby Creek above station LB 2000. Water quality in Libby Creek at this location would also be

Table 6-8. Tailings water quality.

Parameter	Troy Mine Tailings Effluent	Noranda lock-cycle	Troy Mine tailings effluent Jan 1984	May 1987	Mar 1989	Jan 1990	Estimated quality (average)
	(mg/L)						
Total dissolved solids	—	131	256	—	—	218	202
Calcium	13.6	12	—	—	—	—	12.8
Magnesium	3.8	2.3	—	—	—	—	3.1
Sodium	16.6	12	—	—	—	—	14.3
Potassium	22.6	24	—	—	—	—	23.3
Bicarbonate	—	76	—	—	—	—	76
Chloride	4.8	6.1	—	—	—	—	5.5
Sulfate	18.2	12	7.3	42	16	29	20.8
Ammonia	—	—	6.3	—	4.7	9.8	6.9
Nitrate/nitrite	—	—	12	9.1	9.3	18.6	12.3
Aluminum	—	0.1	—	—	—	—	0.1
Arsenic	—	<0.005	—	—	—	<0.005	<0.005
Cadmium	—	<0.001	—	—	—	<0.001	<0.001
Chromium	—	<0.02	—	—	—	<0.02	<0.02
Copper	—	0.02	—	—	—	0.03	0.025
Iron	—	0.08	—	—	—	<0.03	0.06
Lead	—	<0.01	—	—	—	<0.01	<0.01
Manganese	—	0.09	—	—	—	0.83	0.46
Mercury	—	<0.001	—	—	—	<0.001	<0.001
Molybdenum	—	0.01	—	—	—	—	0.01
Silver	—	<0.005	—	—	—	<0.005	<0.005
Zinc	—	0.05	—	—	—	0.02	0.035

Sources: Noranda Minerals Corp. 1989a, 1989h.
ASARCO, Inc. 1990.
Metals concentrations are dissolved.

affected by seepage from the percolation pond/land application area.

After Year 1, all excess mine water would be used in the mill process circuit, and discharge of excess mine water in the percolation pond/land application area would not be required. The percolation pond and land application system would remain in place as backup in case mine inflows exceed the predicted rate. However, no discharge from this source is anticipated.

Seepage from the bottom of the tailings impoundment would increase over the project life, reaching a maximum seepage rate of 475 gpm in Year 16. A portion of this seepage would be intercepted by the proposed pressure relief well system and returned to the impoundment. Noranda (1990) estimates that 280 gpm of this seepage would enter shallow ground water systems which discharge to Libby Creek in Year 16 of operations.

For the purpose of the loading analysis, individual water quality concentrations were estimated using the following equation—

$$C_E = \frac{C_1Q_1 + C_2Q_2 + C_3Q_3 + C_4Q_4}{Q_1 + Q_2 + Q_3 + Q_4}$$

Where—

C_E is the estimated concentration in Libby Creek,

C_1 is the observed concentration during baseline monitoring,

Q_1 is the projected streamflow under existing conditions,

C_2 is the estimated adit water concentration,

Q_2 is the estimated adit water discharge,

C_3 is the estimated mine water concentration,

Q_3 is the estimated mine water discharge,

C_4 is the estimated tailings water concentration, and

Q_4 is the estimated tailings water discharge.

Loading analysis for low flow and average flow conditions are provided in Tables 6-9 through 6-16, respectively. Analyses of the discharges that would occur during adit construction (Year 1 of construction) and during development of the mine workings (Years 2 and 3 of construction) was performed for station LB-800 on Libby Creek (see Figure 6-1). This station is located downstream (and downgradient with respect to ground water flow) of the excess mine water disposal areas. Station LB-800 is located upstream of the Little Cherry Creek tailings impoundment area. The tailings impoundment would be constructed during Year 1 of operations.

Two of the scenarios analyze the discharges that would occur during Years 1 and 16 of the proposed operation and both scenarios include discharges from the Little Cherry Creek tailings impoundment. For these scenarios, loading was analyzed at station LB-2000, which is located downstream of the Montanore Project area (see Figure 6-1).

This loading analysis, which is based upon the operations scenarios discussed above, represents neither a "best case" nor a "worst case" analysis. Mine inflow and pumping rates, and tailings impoundment seepage rates may be greater than or less than the rates used in this analysis. The actual quality of the adit water, mine water, and tailings pond water may be different (better or worse) than expected. Therefore, the actual stream water quality changes observed during operations may be better or worse than these projections.

Two other scenarios were analyzed in Alternative 3. Under Alternative 3, Noranda would pipe mine and adit water to a water treatment system constructed near the tailings impoundment. As discussed in Chapter 2, three water treatment methods are analyzed—wetland, evaporator, and electro-coagulator. Tables 6-17 through 6-22 presents the loading calculations for discharge of mine and adit water following treatment by the three treatment alternatives.

Also under Alternative 3, Noranda would construct a seepage collection system beneath the tailings impoundment to collect tailings water prior to

entering ground water. The agencies have estimated that the collection system would collect 300 gpm of tailings water. An estimated 85 gpm would be intercepted by Noranda's pressure relief system and the remaining 85 gpm (out of the total estimated 475 gpm of tailings seepage in Year 16 of operations) would discharge untreated into the underlying aquifer and ultimately to Libby Creek. Tables 6-23 through 6-28 presents the loading calculations for discharge of tailings water following treatment by the three treatment alternatives.

In addition to the scenarios identified above, the following assumptions have been made in the loading analysis—

- In the loading calculation, below detection limit values were assumed to equal the analytical detection limit.
- Since the seepage must reach surface water bodies following a ground water pathway, dissolved metal concentrations were used for the loading analysis.
- The loading analysis did not consider physical and chemical processes in the ground water system that may, at least temporarily, reduce the concentrations of some parameters. Many metals readily adsorb onto the surface of soil particles or are trapped by clays through ion exchange (Fetter, 1988). However, soil attenuation tests performed for Noranda (1990) were inconclusive and the amount of attenuation that would occur cannot be quantified.
- In performing the loading analysis, it was assumed that in-stream flows would not be reduced by surface water withdrawals or reduced by ground water inflows into the mine.
- The loading analysis is based upon steady state and average conditions. Short-term, high rate inflows may temporarily occur as mine workings encounter and dewater saturated fractures. Seasonal variations in precipitation and evaporation, as well as the occurrence of wet years, may require the periodic disposal of excess tailings water in the percolation pond/land application area.
- Seepage from the tailings pond and percolation ponds is assumed to instantaneously reach receiving stream. Actual ground water travel times could be years to tens of years. Travel times for specific chemical constituents may be longer. However, hydrogeologic conditions at the tailings disposal area may shorten the ground water flow path.

Table 6-9. Loading calculations for LB 800 during low flow conditions following discharge of adit water only.

Parameter	Existing conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)	Mine water Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)
Total dissolved solids	28	4.4	200	0.00	172	0.87	52	5.3
Ammonia	<0.05	4.4	9.0	0.00	9.0	0.87	<1.5	5.3
Nitrate/nitrite	0.04	4.4	17.3	0.00	9.22	0.87	1.6	5.3
Aluminum	<0.1	4.4	<0.1	0.00	0.1	0.87	<0.1	5.3
Arsenic	<0.005	4.4	<0.005	0.00	<0.005	0.87	<0.005	5.3
Cadmium	0.0006	4.4	<0.0010	0.00	<0.0010	0.87	<0.0007	5.3
Chromium	<0.02	4.4	---	0.00	<0.02	0.87	<0.02	5.3
Copper	<0.001	4.4	0.073	0.00	<0.010	0.87	<0.002	5.3
Iron	<0.05	4.4	---	0.00	<0.05	0.87	<0.05	5.3
Lead	<0.001	4.4	<0.01	0.00	<0.01	0.87	<0.002	5.3
Manganese	<0.02	4.4	0.49	0.00	<0.02	0.87	<0.02	5.3
Mercury	<0.0002	4.4	<0.001	0.00	<0.0002	0.87	<0.0002	5.3
Molybdenum	<0.05	4.4	---	0.00	<0.05	0.87	<0.05	5.3
Silver	<0.0002	4.4	<0.005	0.00	<0.001	0.87	<0.0003	5.3
Zinc	<0.02	4.4	0.02	0.00	<0.02	0.87	<0.02	5.3

Source: Loading analysis by IMS Inc. 1990.

Table 6-10. Loading calculations for LB 800 during average flow conditions following discharge of adit water only.

Parameter	Existing conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)	Mine water Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)
Total dissolved solids	17	62.0	200	0.00	172	0.87	19	62.9
Ammonia	0.07	62.0	9.0	0.00	9.0	0.87	0.2	62.9
Nitrate/nitrite	0.07	62.0	17.3	0.00	9.22	0.87	0.2	62.9
Aluminum	<0.1	62.0	<0.1	0.00	0.1	0.87	<0.1	62.9
Arsenic	<0.005	62.0	<0.005	0.00	<0.005	0.87	<0.005	62.9
Cadmium	0.0007	62.0	<0.0010	0.00	<0.0010	0.87	<0.0007	62.9
Chromium	<0.02	62.0	<0.02	0.00	<0.02	0.87	<0.02	62.9
Copper	0.002	62.0	0.073	0.00	<0.010	0.87	<0.002	62.9
Iron	0.05	62.0	<0.05	0.00	<0.05	0.87	<0.05	62.9
Lead	0.001	62.0	<0.01	0.00	<0.01	0.87	<0.001	62.9
Manganese	<0.02	62.0	0.49	0.00	<0.02	0.87	<0.02	62.9
Mercury	<0.0002	62.0	<0.001	0.00	<0.0002	0.87	<0.0002	62.9
Molybdenum	<0.05	62.0	<0.05	0.00	<0.05	0.87	<0.05	62.9
Silver	0.0002	62.0	<0.005	0.00	<0.001	0.87	<0.0002	62.9
Zinc	<0.02	62.0	0.02	0.00	<0.02	0.87	<0.02	62.9

Source: Loading analysis by IMS Inc. 1990.

Table 6-11. Loading calculations for LB 800 during low flow conditions following discharge of adit water and mine water.

Parameter	Existing conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)	Mine water Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek Conc. (mg/L)	Flow (cfs)
Total dissolved solids	28	4.4	200	1.25	172	0.87	80	6.5
Ammonia	<0.05	4.4	9.0	1.25	9.0	0.87	<3.0	6.5
Nitrate/nitrite	0.04	4.4	17.3	1.25	9.22	0.87	4.6	6.5
Aluminum	<0.1	4.4	<0.1	1.25	0.1	0.87	<0.1	6.5
Arsenic	<0.005	4.4	<0.005	1.25	<0.005	0.87	<0.005	6.5
Cadmium	0.0006	4.4	<0.0010	1.25	<0.0010	0.87	<0.0007	6.5
Chromium	<0.02	4.4	<0.02	1.25	<0.02	0.87	<0.02	6.5
Copper	<0.001	4.4	0.073	1.25	<0.010	0.87	<0.016	6.5
Iron	<0.05	4.4	<0.05	1.25	<0.05	0.87	<0.05	6.5
Lead	<0.001	4.4	<0.01	1.25	<0.01	0.87	<0.004	6.5
Manganese	<0.02	4.4	0.49	1.25	<0.02	0.87	<0.11	6.5
Mercury	<0.0002	4.4	<0.001	1.25	<0.0002	0.87	<0.0004	6.5
Molybdenum	<0.05	4.4	<0.05	1.25	<0.05	0.87	<0.05	6.5
Silver	<0.0002	4.4	<0.005	1.25	<0.001	0.87	<0.0012	6.5
Zinc	<0.02	4.4	0.02	1.25	<0.02	0.87	<0.02	6.5

Source: Loading analysis by IMS Inc. 1990.

Table 6-12. Loading calculations for LB 800 during average flow conditions following discharge of adit water and mine water.

Parameter	Existing conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)	Mine water Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)
Total dissolved solids	17	62.0	200	1.25	172	0.87	23	64.1
Ammonia	0.07	62.0	9.0	1.25	9.0	0.87	0.4	64.1
Nitrate/nitrite	0.07	62.0	17.3	1.25	9.22	0.87	0.5	64.1
Aluminum	<0.1	62.0	<0.1	1.25	0.1	0.87	<0.1	64.1
Arsenic	<0.005	62.0	<0.005	1.25	<0.005	0.87	<0.005	64.1
Cadmium	0.0007	62.0	<0.0010	1.25	<0.0010	0.87	<0.0007	64.1
Chromium	<0.02	62.0	<0.02	1.25	<0.02	0.87	<0.02	64.1
Copper	0.002	62.0	0.073	1.25	<0.010	0.87	<0.003	64.1
Iron	0.05	62.0	<0.05	1.25	<0.05	0.87	<0.05	64.1
Lead	0.001	62.0	<0.01	1.25	<0.01	0.87	<0.001	64.1
Manganese	<0.02	62.0	0.49	1.25	<0.02	0.87	<0.03	64.1
Mercury	<0.0002	62.0	<0.001	1.25	<0.0002	0.87	<0.0002	64.1
Molybdenum	<0.05	62.0	<0.05	1.25	<0.05	0.87	<0.05	64.1
Silver	0.0002	62.0	<0.005	1.25	<0.001	0.87	<0.0003	64.1
Zinc	<0.02	62.0	0.02	1.25	<0.02	0.87	<0.02	64.1

Source: Loading analysis by IMS Inc. 1990.

Table 6-13. **Loading calculations for LB 2000 during low flow conditions following discharge of adit water at LB 800 and tailings effluent at LB 2000.**

Parameter	Existing conditions Libby Creek (LB 2000) Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Tailings effluent Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek Conc. (mg/L)	Flow (cfs)
Total dissolved solids	41	8.7	172	0.15	202	0.11	45	8.96
Ammonia	<0.05	8.7	9.0	0.15	6.9	0.11	<0.3	9.0
Nitrate/nitrite	0.03	8.7	9.22	0.15	12.3	0.11	0.3	9.0
Aluminum	<0.1	8.7	0.1	0.15	0.1	0.11	<0.1	9.0
Arsenic	<0.005	8.7	<0.005	0.15	<0.005	0.11	<0.005	9.0
Cadmium	0.0007	8.7	<0.0010	0.15	<0.0010	0.11	<0.0010	9.0
Chromium	<0.02	8.7	<0.02	0.15	<0.02	0.11	<0.02	9.0
Copper	<0.001	8.7	<0.01	0.15	<0.025	0.11	<0.001	9.0
Iron	<0.05	8.7	<0.05	0.15	0.06	0.11	<0.05	9.0
Lead	<0.001	8.7	<0.01	0.15	<0.010	0.11	<0.001	9.0
Manganese	<0.02	8.7	<0.02	0.15	0.46	0.11	<0.03	9.0
Mercury	<0.0002	8.7	<0.0002	0.15	<0.0010	0.11	<0.0002	9.0
Molybdenum	<0.05	8.7	<0.05	0.15	0.01	0.11	<0.05	9.0
Silver	0.0003	8.7	<0.001	0.15	<0.005	0.11	<0.0004	9.0
Zinc	<0.02	8.7	<0.02	0.15	<0.04	0.11	<0.02	9.0

Source: Loading analysis by IMS Inc. 1990.

Table 6-14. **Loading calculations for LB 2000 during average flow conditions following discharge of adit water at LB 800 and tailings water at LB 2000.**

Parameter	Existing conditions Libby Creek (LB 2000) Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Tailings effluent Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek Conc. (mg/L)	Flow (cfs)
Total dissolved solids	20	122.0	172	0.15	202	0.11	20	122.3
Ammonia	<0.08	122.0	9.0	0.15	6.9	0.11	<0.1	122.3
Nitrate/nitrite	0.06	122.0	9.22	0.15	12.3	0.11	0.1	122.3
Aluminum	<0.1	122.0	0.1	0.15	0.1	0.11	<0.1	122.3
Arsenic	<0.005	122.0	<0.005	0.15	<0.005	0.11	<0.005	122.3
Cadmium	0.0004	122.0	<0.0010	0.15	<0.0010	0.11	<0.0004	122.3
Chromium	<0.02	122.0	<0.02	0.15	<0.02	0.11	<0.02	122.3
Copper	0.002	122.0	<0.010	0.15	<0.030	0.11	<0.002	122.3
Iron	0.05	122.0	<0.05	0.15	<0.06	0.11	<0.05	122.3
Lead	<0.001	122.0	<0.01	0.15	<0.01	0.11	<0.001	122.3
Manganese	<0.02	122.0	<0.02	0.15	0.46	0.11	<0.02	122.3
Mercury	<0.0002	122.0	<0.0002	0.15	<0.0010	0.11	<0.0002	122.3
Molybdenum	<0.05	122.0	<0.05	0.15	<0.01	0.11	<0.05	122.3
Silver	0.0003	122.0	<0.001	0.15	<0.005	0.11	<0.0003	122.3
Zinc	<0.02	122.0	<0.02	0.15	<0.04	0.11	<0.02	122.3

Source: Loading analysis by IMS Inc. 1990.

Table 6-15. Loading calculations for LB 2000 during low flow conditions following discharge of tailings effluent.

Parameter	Existing conditions Libby Creek (LB 2000) Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Tailings effluent Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek Conc. (mg/L)	Flow (cfs)
Total dissolved solids	41	8.7	172	0.00	202	0.62	52	9.32
Ammonia	<0.05	8.7	9.0	0.00	6.9	0.62	<0.5	9.32
Nitrate/nitrite	0.03	8.7	9.22	0.00	12.3	0.62	0.9	9.32
Aluminum	<0.1	8.7	0.1	0.00	<0.1	0.62	<0.1	9.32
Arsenic	<0.005	8.7	<0.005	0.00	<0.005	0.62	<0.005	9.32
Cadmium	0.0010	8.7	<0.0010	0.00	<0.0010	0.62	<0.0010	9.32
Chromium	<0.02	8.7	<0.02	0.00	<0.02	0.62	<0.02	9.32
Copper	<0.001	8.7	<0.010	0.00	<0.025	0.62	<0.003	9.32
Iron	<0.05	8.7	<0.05	0.00	0.06	0.62	<0.05	9.32
Lead	<0.001	8.7	<0.010	0.00	<0.010	0.62	<0.002	9.32
Manganese	<0.02	8.7	<0.02	0.00	0.46	0.62	<0.05	9.32
Mercury	<0.0002	8.7	<0.000	0.00	<0.0010	0.62	<0.0003	9.32
Molybdenum	<0.05	8.7	<0.05	0.00	<0.01	0.62	<0.05	9.32
Silver	0.0003	8.7	<0.001	0.00	<0.005	0.62	<0.0006	9.32
Zinc	<0.02	8.7	<0.02	0.00	<0.04	0.62	<0.02	9.32

Source: Loading analysis by IMS Inc. 1990.

Table 6-16. Loading calculations for LB 2000 during average flow conditions following discharge of tailings effluent.

Parameter	Existing conditions Libby Creek (LB 800) Conc. (mg/L)	Flow (cfs)	Adit water Conc. (mg/L)	Flow (cfs)	Tailings effluent Conc. (mg/L)	Flow (cfs)	Projected conditions Libby Creek Conc. (mg/L)	Flow (cfs)
Total dissolved solids	20	122.0	172	0.00	202	0.62	21	122.6
Ammonia	<0.08	122.0	9.0	0.00	6.9	0.62	<0.1	122.6
Nitrate/nitrite	0.06	122.0	9.22	0.00	12.3	0.62	0.10	122.6
Aluminum	<0.1	122.0	0.1	0.00	<0.1	0.62	<0.1	122.6
Arsenic	<0.005	122.0	<0.005	0.00	<0.005	0.62	<0.005	122.6
Cadmium	0.0004	122.0	<0.0010	0.00	<0.0010	0.62	<0.0004	122.6
Chromium	<0.02	122.0	<0.02	0.00	<0.02	0.62	<0.02	122.6
Copper	0.002	122.0	<0.010	0.00	<0.025	0.62	<0.002	122.6
Iron	0.05	122.0	<0.05	0.00	0.06	0.62	<0.05	122.6
Lead	<0.001	122.0	<0.010	0.00	<0.010	0.62	<0.001	122.6
Manganese	<0.02	122.0	<0.02	0.00	0.46	0.62	<0.02	122.6
Mercury	<0.0002	122.0	<0.000	0.00	<0.0010	0.62	<0.0002	122.6
Molybdenum	<0.05	122.0	<0.05	0.00	<0.01	0.62	<0.05	122.6
Silver	0.0003	122.0	<0.001	0.00	<0.005	0.62	<0.0003	122.6
Zinc	<0.02	122.0	<0.02	0.00	<0.04	0.62	<0.02	122.6

Source: Loading analysis by IMS Inc. 1990.

Table 6-17. Loading calculations for LB 2000 during low flow conditions following discharge of mine and adit water and wetland treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	200	1.25	172	0.87	0	188	2.12	70	10.8
Ammonia	<0.05	8.7	9.0	1.25	9.0	0.87	79	1.9	2.12	<0.41	10.8
Nitrate/nitrite	0.03	8.7	17.3	1.25	9.22	0.87	73	3.8	2.12	0.76	10.8
Aluminum	<0.1	8.7	<0.1	1.25	0.1	0.87	43	<0.1	2.12	<0.1	10.8
Arsenic	<0.005	8.7	<0.005	1.25	<0.005	0.87	0	<0.005	2.12	<0.005	10.8
Cadmium	<0.0010	8.7	<0.0010	1.25	<0.0010	0.87	99	<0.0001	2.12	<0.0008	10.8
Chromium	<0.02	8.7	<0.02	1.25	<0.02	0.87	70	<0.02	2.12	<0.02	10.8
Copper	<0.001	8.7	0.073	1.25	<0.010	0.87	99	<0.001	2.12	<0.001	10.8
Iron	<0.05	8.7	<0.05	1.25	<0.05	0.87	70	<0.05	2.12	<0.05	10.8
Lead	<0.001	8.7	<0.01	1.25	<0.01	0.87	71	<0.003	2.12	<0.001	10.8
Manganese	<0.02	8.7	0.49	1.25	<0.02	0.87	66	0.10	2.12	<0.04	10.8
Mercury	<0.0002	8.7	<0.0010	1.25	<0.0002	0.87	70	<0.0002	2.12	<0.0002	10.8
Molybdenum	<0.05	8.7	<0.05	1.25	<0.05	0.87	0	<0.05	2.12	<0.05	10.8
Silver	0.0003	8.7	<0.005	1.25	<0.001	0.87	95	<0.0002	2.12	<0.0003	10.8
Zinc	<0.02	8.7	<0.02	1.25	<0.02	0.87	97	<0.02	2.12	<0.02	10.8

Source: Loading analysis by IMS Inc. 1990.

Table 6-18. Loading calculations for LB 2000 during average flow conditions following discharge of mine and adit water and wetland treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122	200	1.25	172	0.87	0	188	2.12	23	124.1
Ammonia	0.08	122	9.0	1.25	9.0	0.87	79	1.9	2.12	0.11	124.1
Nitrate/nitrite	0.06	122	17.3	1.25	9.22	0.87	73	3.8	2.12	0.12	124.1
Aluminum	<0.1	122	<0.1	1.25	0.1	0.87	43	<0.1	2.12	<0.1	124.1
Arsenic	<0.005	122	<0.005	1.25	<0.005	0.87	0	<0.005	2.12	<0.005	124.1
Cadmium	0.0004	122	<0.0010	1.25	<0.0010	0.87	99	<0.0001	2.12	<0.0004	124.1
Chromium	<0.02	122	<0.02	1.25	<0.02	0.87	70	<0.02	2.12	<0.02	124.1
Copper	0.002	122	0.073	1.25	<0.010	0.87	99	<0.001	2.12	<0.002	124.1
Iron	0.05	122	<0.05	1.25	<0.05	0.87	70	<0.05	2.12	<0.05	124.1
Lead	<0.001	122	<0.01	1.25	<0.01	0.87	71	<0.003	2.12	<0.001	124.1
Manganese	<0.02	122	0.49	1.25	<0.02	0.87	66	0.10	2.12	<0.02	124.1
Mercury	<0.0002	122	<0.0010	1.25	<0.0002	0.87	70	<0.0002	2.12	<0.0002	124.1
Molybdenum	<0.05	122	<0.05	1.25	<0.05	0.87	0	<0.05	2.12	<0.05	124.1
Silver	0.0003	122	<0.005	1.25	<0.001	0.87	95	<0.0002	2.12	<0.0003	124.1
Zinc	<0.02	122	<0.02	1.25	<0.02	0.87	97	<0.02	2.12	<0.02	124.1

Source: Loading analysis by IMS Inc. 1990.

Table 6-19. Loading calculations for LB 2000 during low flow conditions following discharge of mine and adit water and electrocoagulator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	200	1.25	172	0.87	95	9	2.12	35	10.8
Ammonia	<0.05	8.7	9.0	1.25	9.0	0.87	0	9.0	2.12	<1.81	10.8
Nitrate/nitrite	0.03	8.7	17.3	1.25	9.22	0.87	74	3.6	2.12	0.74	10.8
Aluminum	<0.1	8.7	<0.1	1.25	0.1	0.87	75	<0.1	2.12	<0.1	10.8
Arsenic	<0.005	8.7	<0.005	1.25	<0.005	0.87	37	<0.005	2.12	<0.005	10.8
Cadmium	<0.0010	8.7	<0.0010	1.25	<0.0010	0.87	98	<0.0001	2.12	<0.0008	10.8
Chromium	<0.02	8.7	<0.02	1.25	<0.02	0.87	98	<0.02	2.12	<0.02	10.8
Copper	<0.001	8.7	0.073	1.25	<0.010	0.87	97	0.001	2.12	<0.001	10.8
Iron	<0.05	8.7	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	10.8
Lead	<0.001	8.7	<0.01	1.25	<0.01	0.87	76	<0.002	2.12	<0.001	10.8
Manganese	<0.02	8.7	0.49	1.25	<0.02	0.87	71	0.09	2.12	<0.03	10.8
Mercury	<0.0002	8.7	<0.0010	1.25	<0.0002	0.87	50	<0.0003	2.12	<0.0002	10.8
Molybdenum	<0.05	8.7	<0.05	1.25	<0.05	0.87	50	<0.05	2.12	<0.05	10.8
Silver	0.0003	8.7	<0.005	1.25	<0.001	0.87	97	<0.0002	2.12	<0.0003	10.8
Zinc	<0.02	8.7	<0.02	1.25	<0.02	0.87	96	<0.02	2.12	<0.02	10.8

Source: Loading analysis by IMS Inc. 1990.

Table 6-20. Loading calculations for LB 2000 during average flow conditions following discharge of mine and adit water and electrocoagulator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122	200	1.25	172	0.87	95	9	2.12	20	124.1
Ammonia	0.08	122	9.0	1.25	9.0	0.87	0	9.0	2.12	0.23	124.1
Nitrate/nitrite	0.06	122	17.3	1.25	9.22	0.87	74	3.6	2.12	0.12	124.1
Aluminum	<0.1	122	<0.1	1.25	0.1	0.87	75	<0.1	2.12	<0.1	124.1
Arsenic	<0.005	122	<0.005	1.25	<0.005	0.87	37	<0.005	2.12	<0.005	124.1
Cadmium	0.0004	122	<0.0010	1.25	<0.0010	0.87	98	<0.0001	2.12	<0.0004	124.1
Chromium	<0.02	122	<0.02	1.25	<0.02	0.87	98	<0.02	2.12	<0.02	124.1
Copper	0.002	122	0.073	1.25	<0.010	0.87	97	0.001	2.12	<0.002	124.1
Iron	0.05	122	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	124.1
Lead	<0.001	122	<0.01	1.25	<0.01	0.87	76	<0.002	2.12	<0.001	124.1
Manganese	<0.02	122	0.49	1.25	<0.02	0.87	71	0.09	2.12	<0.02	124.1
Mercury	<0.0002	122	<0.0010	1.25	<0.0002	0.87	50	<0.0003	2.12	<0.0002	124.1
Molybdenum	<0.05	122	<0.05	1.25	<0.05	0.87	50	<0.05	2.12	<0.05	124.1
Silver	0.0003	122	<0.005	1.25	<0.001	0.87	97	<0.0002	2.12	<0.0003	124.1
Zinc	<0.02	122	<0.02	1.25	<0.02	0.87	96	<0.02	2.12	<0.02	124.1

Source: Loading analysis by IMS Inc. 1990.

Table 6-21. Loading calculations for LB 2000 during low flow conditions following discharge of mine and adit water and evaporator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	200	1.25	172	0.87	95	9	2.12	35	10.8
Ammonia	<0.05	8.7	9.0	1.25	9.0	0.87	95	0.5	2.12	<0.13	10.8
Nitrate/nitrite	0.03	8.7	17.3	1.25	9.22	0.87	95	0.7	2.12	0.16	10.8
Aluminum	<0.1	8.7	<0.1	1.25	0.1	0.87	95	<0.1	2.12	<0.1	10.8
Arsenic	<0.005	8.7	<0.005	1.25	<0.005	0.87	95	<0.005	2.12	<0.005	10.8
Cadmium	<0.0010	8.7	<0.0010	1.25	<0.0010	0.87	95	<0.0001	2.12	<0.0008	10.8
Chromium	<0.02	8.7	<0.02	1.25	<0.02	0.87	95	<0.02	2.12	<0.02	10.8
Copper	<0.001	8.7	0.073	1.25	<0.010	0.87	95	0.002	2.12	<0.001	10.8
Iron	<0.05	8.7	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	10.8
Lead	<0.001	8.7	<0.01	1.25	<0.01	0.87	95	<0.001	2.12	<0.001	10.8
Manganese	<0.02	8.7	0.49	1.25	<0.02	0.87	95	0.02	2.12	<0.02	10.8
Mercury	<0.0002	8.7	<0.0010	1.25	<0.0002	0.87	95	<0.0002	2.12	<0.0002	10.8
Molybdenum	<0.05	8.7	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	10.8
Silver	0.0003	8.7	<0.005	1.25	<0.001	0.87	95	<0.0002	2.12	<0.0003	10.8
Zinc	<0.02	8.7	<0.02	1.25	<0.02	0.87	95	<0.02	2.12	<0.02	10.8

Source: Loading analysis by IMS Inc. 1990.

Table 6-22. Loading calculations for LB 2000 during average flow conditions following discharge of mine and adit water and evaporator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Mine water Conc. (mg/L)	Mine water Flow (cfs)	Adit water Conc. (mg/L)	Adit water Flow (cfs)	Removal (%)	Treated water Conc. (mg/L)	Treated water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122	200	1.25	172	0.87	95	9	2.12	20	124.1
Ammonia	0.08	122	9.0	1.25	9.0	0.87	95	0.5	2.12	0.09	124.1
Nitrate/nitrite	0.06	122	17.3	1.25	9.22	0.87	95	0.7	2.12	0.07	124.1
Aluminum	<0.1	122	<0.1	1.25	0.1	0.87	95	<0.1	2.12	<0.1	124.1
Arsenic	<0.005	122	<0.005	1.25	<0.005	0.87	95	<0.005	2.12	<0.005	124.1
Cadmium	0.0004	122	<0.0010	1.25	<0.0010	0.87	95	<0.0001	2.12	<0.0004	124.1
Chromium	<0.02	122	<0.02	1.25	<0.02	0.87	95	<0.02	2.12	<0.02	124.1
Copper	0.002	122	0.073	1.25	<0.010	0.87	95	0.002	2.12	<0.002	124.1
Iron	0.05	122	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	124.1
Lead	<0.001	122	<0.01	1.25	<0.01	0.87	95	<0.001	2.12	<0.001	124.1
Manganese	<0.02	122	0.49	1.25	<0.02	0.87	95	0.02	2.12	<0.02	124.1
Mercury	<0.0002	122	<0.0010	1.25	<0.0002	0.87	95	<0.0002	2.12	<0.0002	124.1
Molybdenum	<0.05	122	<0.05	1.25	<0.05	0.87	95	<0.05	2.12	<0.05	124.1
Silver	0.0003	122	<0.005	1.25	<0.001	0.87	95	<0.0002	2.12	<0.0003	124.1
Zinc	<0.02	122	<0.02	1.25	<0.02	0.87	95	<0.02	2.12	<0.02	124.1

Source: Loading analysis by IMS Inc. 1990.

Table 6-23. Loading calculations for LB 2000 during low flow conditions following discharge of tailings water and wetland treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	202	0.20	202	0.67	0	202		56	9.6
Ammonia	<0.05	8.7	6.9	0.20	6.9	0.67	79	1.4		<0.29	9.6
Nitrate/nitrite	0.03	8.7	12.3	0.20	12.3	0.67	73	3.3		0.52	9.6
Aluminum	<0.1	8.7	<0.1	0.20	<0.1	0.67	43	<0.1		<0.1	9.6
Arsenic	<0.005	8.7	<0.005	0.20	<0.005	0.67	0	<0.005		<0.005	9.6
Cadmium	<0.0010	8.7	<0.0010	0.20	<0.0010	0.67	99	<0.0001		<0.0009	9.6
Chromium	<0.02	8.7	<0.02	0.20	<0.02	0.67	70	<0.02		<0.02	9.6
Copper	<0.001	8.7	<0.025	0.20	<0.025	0.67	99	<0.001		<0.002	9.6
Iron	<0.05	8.7	0.06	0.20	0.06	0.67	70	<0.05		<0.05	9.6
Lead	<0.001	8.7	<0.010	0.20	<0.010	0.67	71	<0.003		<0.001	9.6
Manganese	<0.02	8.7	0.46	0.20	0.46	0.67	66	0.16		<0.04	9.6
Mercury	<0.0002	8.7	<0.0010	0.20	<0.0010	0.67	70	<0.0003		<0.0002	9.6
Molybdenum	<0.05	8.7	<0.01	0.20	<0.01	0.67	0	<0.05		<0.05	9.6
Silver	0.0003	8.7	<0.005	0.20	<0.005	0.67	95	<0.0003		<0.0004	9.6
Zinc	<0.02	8.7	<0.04	0.20	<0.04	0.67	97	<0.02		<0.02	9.6

Source: Loading analysis by IMS Inc. 1990.

Table 6-24. Loading calculations for LB 2000 during average flow conditions following discharge of tailings water and wetland treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122.0	202	0.20	202	0.67	0	202	0.67	21	122.9
Ammonia	0.08	122.0	6.9	0.20	6.9	0.67	79	1.4	0.67	<0.10	122.9
Nitrate/nitrite	0.06	122.0	12.3	0.20	12.3	0.67	73	3.3	0.67	0.09	122.9
Aluminum	<0.1	122.0	<0.1	0.20	<0.1	0.67	43	<0.1	0.67	<0.1	122.9
Arsenic	<0.005	122.0	<0.005	0.20	<0.005	0.67	0	<0.005	0.67	<0.005	122.9
Cadmium	0.0004	122.0	<0.0010	0.20	<0.0010	0.67	99	<0.0001	0.67	<0.0004	122.9
Chromium	<0.02	122.0	<0.02	0.20	<0.02	0.67	70	<0.02	0.67	<0.02	122.9
Copper	0.002	122.0	<0.025	0.20	<0.025	0.67	99	<0.001	0.67	<0.002	122.9
Iron	0.05	122.0	0.06	0.20	0.06	0.67	70	<0.05	0.67	<0.05	122.9
Lead	<0.001	122.0	<0.010	0.20	<0.010	0.67	71	<0.003	0.67	<0.001	122.9
Manganese	<0.02	122.0	0.46	0.20	0.46	0.67	66	0.16	0.67	<0.02	122.9
Mercury	<0.0002	122.0	<0.0010	0.20	<0.0010	0.67	70	<0.0003	0.67	<0.0002	122.9
Molybdenum	<0.05	122.0	<0.01	0.20	<0.01	0.67	0	<0.05	0.67	<0.05	122.9
Silver	0.0003	122.0	<0.005	0.20	<0.005	0.67	95	<0.0003	0.67	<0.0003	122.9
Zinc	<0.02	122.0	<0.04	0.20	<0.04	0.67	97	<0.02	0.67	<0.02	122.9

Source: Loading analysis by IMS Inc. 1990.

Table 6-25. Loading calculations for LB 2000 during low flow conditions following discharge of tailings water and electrocoagulator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	202	0.20	202	0.67	95	10	0.67	42	9.6
Ammonia	<0.05	8.7	6.9	0.20	6.9	0.67	0	6.9	0.67	<0.67	9.6
Nitrate/nitrite	0.03	8.7	12.3	0.20	12.3	0.67	74	3.2	0.67	0.51	9.6
Aluminum	<0.1	8.7	<0.1	0.20	<0.1	0.67	75	<0.1	0.67	<0.1	9.6
Arsenic	<0.005	8.7	<0.005	0.20	<0.005	0.67	37	<0.005	0.67	<0.005	9.6
Cadmium	<0.0010	8.7	<0.0010	0.20	<0.0010	0.67	98	<0.0001	0.67	<0.0009	9.6
Chromium	<0.02	8.7	<0.02	0.20	<0.02	0.67	98	<0.02	0.67	<0.02	9.6
Copper	<0.001	8.7	<0.025	0.20	<0.025	0.67	97	<0.001	0.67	<0.002	9.6
Iron	<0.05	8.7	0.06	0.20	0.06	0.67	95	<0.05	0.67	<0.05	9.6
Lead	<0.001	8.7	<0.010	0.20	<0.010	0.67	76	<0.002	0.67	<0.001	9.6
Manganese	<0.02	8.7	0.46	0.20	0.46	0.67	71	0.13	0.67	<0.04	9.6
Mercury	<0.0002	8.7	<0.0010	0.20	<0.0010	0.67	50	<0.0005	0.67	<0.0002	9.6
Molybdenum	<0.05	8.7	<0.01	0.20	<0.01	0.67	50	<0.05	0.67	<0.05	9.6
Silver	0.0003	8.7	<0.005	0.20	<0.005	0.67	97	<0.0002	0.67	<0.0004	9.6
Zinc	<0.02	8.7	<0.04	0.20	<0.04	0.67	96	<0.02	0.67	<0.02	9.6

Source: Loading analysis by IMS Inc. 1990.

Table 6-26. Loading calculations for LB 2000 during average flow conditions following discharge of mine and adit water and electrocoagulator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122	202	0.20	202	0.67	0	202	0.67	21	122.9
Ammonia	0.08	122	6.9	0.20	6.9	0.67	79	1.4	0.67	<0.10	122.9
Nitrate/nitrite	0.06	122	12.3	0.20	12.3	0.67	73	3.3	0.67	0.09	122.9
Aluminum	<0.1	122	<0.1	0.20	<0.1	0.67	43	<0.1	0.67	<0.1	122.9
Arsenic	<0.005	122	<0.005	0.20	<0.005	0.67	0	<0.005	0.67	<0.005	122.9
Cadmium	0.0004	122	<0.0010	0.20	<0.0010	0.67	99	<0.0001	0.67	<0.0004	122.9
Chromium	<0.02	122	<0.02	0.20	<0.02	0.67	70	<0.02	0.67	<0.02	122.9
Copper	0.002	122	<0.025	0.20	<0.025	0.67	99	<0.001	0.67	<0.002	122.9
Iron	0.05	122	0.06	0.20	0.06	0.67	70	<0.05	0.67	<0.05	122.9
Lead	<0.001	122	<0.010	0.20	<0.010	0.67	71	<0.003	0.67	<0.001	122.9
Manganese	<0.02	122	0.46	0.20	0.46	0.67	66	0.16	0.67	<0.02	122.9
Mercury	<0.0002	122	<0.0010	0.20	<0.0010	0.67	70	<0.0003	0.67	<0.0002	122.9
Molybdenum	<0.05	122	<0.01	0.20	<0.01	0.67	0	<0.05	0.67	<0.05	122.9
Silver	0.0003	122	<0.005	0.20	<0.005	0.67	95	<0.0003	0.67	<0.0003	122.9
Zinc	<0.02	122	<0.04	0.20	<0.04	0.67	97	<0.02	0.67	<0.02	122.9

Source: Loading analysis by IMS Inc. 1990.

Table 6-27. Loading calculations for LB 2000 during low flow conditions following discharge of tailings water and evaporator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	41	8.7	202	0.20	202	0.67	95	10	0.67	42	9.6
Ammonia	<0.05	8.7	6.9	0.20	6.9	0.67	95	0.3	0.67	<0.21	9.6
Nitrate/nitrite	0.03	8.7	12.3	0.20	12.3	0.67	95	0.6	0.67	0.33	9.6
Aluminum	<0.1	8.7	<0.1	0.20	<0.1	0.67	95	<0.1	0.67	<0.1	9.6
Arsenic	<0.005	8.7	<0.005	0.20	<0.005	0.67	95	<0.005	0.67	<0.005	9.6
Cadmium	<0.0010	8.7	<0.0010	0.20	<0.0010	0.67	95	<0.0001	0.67	<0.0009	9.6
Chromium	<0.02	8.7	<0.02	0.20	<0.02	0.67	95	<0.02	0.67	<0.02	9.6
Copper	<0.001	8.7	<0.025	0.20	<0.025	0.67	95	<0.001	0.67	<0.002	9.6
Iron	<0.05	8.7	0.06	0.20	0.06	0.67	95	<0.05	0.67	<0.05	9.6
Lead	<0.001	8.7	<0.010	0.20	<0.010	0.67	95	<0.001	0.67	<0.001	9.6
Manganese	<0.02	8.7	0.46	0.20	0.46	0.67	95	0.02	0.67	<0.03	9.6
Mercury	<0.0002	8.7	<0.0010	0.20	<0.0010	0.67	95	<0.0002	0.67	<0.0002	9.6
Molybdenum	<0.05	8.7	<0.01	0.20	<0.01	0.67	95	<0.05	0.67	<0.05	9.6
Silver	0.0003	8.7	<0.005	0.20	<0.005	0.67	95	<0.0003	0.67	<0.0004	9.6
Zinc	<0.02	8.7	<0.04	0.20	<0.04	0.67	95	<0.02	0.67	<0.02	9.6

Source: Loading analysis by IMS Inc. 1990.

Table 6-28. Loading calculations for LB 2000 during average flow conditions following discharge of tailings water and evaporator treatment.

Parameter	Existing Libby Creek Conc. (mg/L)	Existing Libby Creek Flow (cfs)	Untreated tailings water Conc. (mg/L)	Untreated tailings water Flow (cfs)	Captured tailings water Conc. (mg/L)	Captured tailings water Flow (cfs)	Removal (%)	Treated tailings water Conc. (mg/L)	Treated tailings water Flow (cfs)	Projected Libby Creek Conc. (mg/L)	Projected Libby Creek Flow (cfs)
Total dissolved solids	20	122	202	0.20	202	0.67	0	202	0.67	21	122.9
Ammonia	0.08	122	6.9	0.20	6.9	0.67	79	1.4	0.67	<0.10	122.9
Nitrate/nitrite	0.06	122	12.3	0.20	12.3	0.67	73	3.3	0.67	0.09	122.9
Aluminum	<0.1	122	<0.1	0.20	<0.1	0.67	43	<0.1	0.67	<0.1	122.9
Arsenic	<0.005	122	<0.005	0.20	<0.005	0.67	0	<0.005	0.67	<0.005	122.9
Cadmium	0.0004	122	<0.0010	0.20	<0.0010	0.67	99	<0.0001	0.67	<0.0004	122.9
Chromium	<0.02	122	<0.02	0.20	<0.02	0.67	70	<0.02	0.67	<0.02	122.9
Copper	0.002	122	<0.025	0.20	<0.025	0.67	99	<0.001	0.67	<0.002	122.9
Iron	0.05	122	0.06	0.20	0.06	0.67	70	<0.05	0.67	<0.05	122.9
Lead	<0.001	122	<0.010	0.20	<0.010	0.67	71	<0.003	0.67	<0.001	122.9
Manganese	<0.02	122	0.46	0.20	0.46	0.67	66	0.16	0.67	<0.02	122.9
Mercury	<0.0002	122	<0.0010	0.20	<0.0010	0.67	70	<0.0003	0.67	<0.0002	122.9
Molybdenum	<0.05	122	<0.01	0.20	<0.01	0.67	0	<0.05	0.67	<0.05	122.9
Silver	0.0003	122	<0.005	0.20	<0.005	0.67	95	<0.0003	0.67	<0.0003	122.9
Zinc	<0.02	122	<0.04	0.20	<0.04	0.67	97	<0.02	0.67	<0.02	122.9

Source: Loading analysis by IMS Inc. 1990.

Wildlife

The primary tool used for assessment of grizzly bear impacts was a Cumulative Effects Model. Additional studies were conducted by the KNF, the USFWS, and Noranda. Available literature was reviewed and specialists in various state and federal agencies were contacted. Details of the model are described in the *Cumulative Effects Analysis Process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems* (U.S. Forest Service, 1988). The CEM analyses the effects of various activities on bear management units (BMUs) which have been established within the CYE to assist in addressing cumulative effects on the grizzly bear and its habitat. Information on the CEM is on file at the KNF.

Soils

The primary impact to soils from transmission line construction probably would be increased erosion from the construction of access roads. Consequently, the analysis focused on disturbance associated with road building. The precise locations of structures and roads would be determined by a centerline survey. In comparing impacts of each alternative, several assumptions were made, as discussed below.

Structure locations. Noranda specified preliminary structure locations for the Miller Creek route and portions of the Swamp Creek route. DNRC and KNF staff made an educated guess at structure locations for the remaining portion of the Swamp Creek, mitigated Miller Creek, and North Miller Creek alternatives. Structure sites were first located along each route on ridge lines and at points where the line would change direction. Structure sites between these points were located at an assumed spacing of 750 feet. All structure locations were plotted on mylar overlays on USGS topographic maps at a scale of 1:24,000.

Access road and trail locations. Existing area roads were drawn on mylar overlays to the USGS topographic maps using information from Noranda, the KNF, and aerial photos. For structure locations not immediately adjacent to an existing road, a preliminary access road location was identified, assuming a road grade less than 12 percent would be required for line construction equipment. Road locations were reviewed and revised where necessary by the KNF personnel to help ensure the roads were suitably located (D. Erwin, KNF Engineer, pers. comm. w/ Tom Ring, DNRC, January 8, 1990). It was assumed that no access road construction would occur on slopes less than 10 percent, since construction vehicles can reach structure sites after on 10 percent slopes or less.

Where sideslopes greater than 10 percent were encountered (E. Netherton, Redpath Engineers, Inc., pers. comm. w/ Tom Ring, DNRC, October 17, 1989), a low standard or primitive road was assumed to provide access for the stringing bulldozer. The need for this primitive access road was assumed along the Miller Creek route where sideslopes greater than 10 percent would be encountered. No access road construction was assumed where the stringing tractor would operate directly up or down a slope. Use of a helicopter to string the conductors was assumed under Alternatives 4, 5 and 6, eliminating the need for primitive roads along the line in steep terrain.

Impacts were estimated assuming mitigating measures proposed by Noranda or the agencies would be implemented. Slope maps (Noranda Minerals Corp., 1989c) and 1:24,000 USGS topographic maps were used to assign slope categories along each alternative. Land type maps (Noranda Minerals Corp., 1989c; Kuenan and Gerhardt, 1984) were used to determine highly erodible soils crossed by each alternative and associated access roads.

Land Use

General background. Information on current and proposed land uses was gathered from the Noranda

applications and maps, the KNF Forest Plan, Kootenai timber sale plans and maps, Special Use Permits, Mineral Material Permits, Plans of Operations, 1984 and 1987 aerial photos, and on-the-ground mapping by DNRC staff.

The KNF Forest Plan (Kootenai National Forest, 1987) identifies how mineral development, roads, and powerline corridors would be designated and managed in different areas of the forest (Vol. 1) and (Vol. 2, Appendix 15, Corridor Criteria). All existing powerlines crossing the forest now are designated and managed under the standards of Management Area 23—Electric Transmission Corridor. Future transmission line corridors are to be designated, using the Forest Plan Appendix 15 criteria. New transmission lines, such as for the Montanore Project, would be approved according to criteria used to manage resources in the areas to be crossed and the standards of Management Area 23—Electric Transmission Corridor.

The Forest Plan identifies areas to be avoided for transmission line siting as "land areas that pose particular land use or environmental impacts that would be difficult or impossible to mitigate (may vary by type of facility)" (Appendix 15). Corridor avoidance areas include developed and primitive recreation areas, research natural areas, certain wildlife habitat areas, steep land, wetlands and slump areas, historical sites, areas with stringent visual objectives, wild, scenic and recreational rivers, nationally classified trails, and state recreation areas. These areas are identified on the Forest Plan Management Area maps. In its analysis, the DNRC totalled the miles of each Management Area crossed by each of the alternative routes and determined whether the management direction for each provided for activities such as logging and crossing by a powerline.

Analysis methods. The DNRC used air photos, Kootenai timber sale maps, and the Noranda application maps (Noranda Minerals Corp., 1989c and 1989d) in its analysis. Areas of past logging or logging that will be completed by 1991 were indicated on a land use map. This map includes roads useable by logging trucks. Necessary new roads were mapped by the DNRC (see Soils). An overlay of the Forest Plan Management Areas was used to determine miles of each area crossed by the line and miles of new roads across each area. Management Areas were placed in one of two categories. The first category included areas where logging was permitted. The other category included areas where recreation or protection of natural features were emphasized over logging. Acres of disturbance along each route were calculated for non-logged lands, using an average of 12.2 acres of forest clearing per mile of powerline, 3 acres of clearing per mile of road construction (varies widely depending on slope), 0.2 acre of clearing per pulling site, and 1 acre of clearing for a storage area for each route. The individual disturbance estimates were then totalled to get a total disturbance estimate. Individual pole disturbances of 0.002 acre per pole were included within the forest clearing estimates.

The miles of unplowed winter access were estimated by using maps to calculate areas that would be more than 0.25 mile from a plowed road and at elevations above 3,500 feet, where end-of-season snow accumulations of two feet or more were assumed to occur.

The estimated timber volumes that would be removed for clearing the powerline right-of-way, stringing sites, and access roads were derived from nearby sales information where the volume to be removed is expected to be about 20,000 board feet per acre, except in regrown burned areas where 10,000 board feet per acre would be removed.

Visual Resources

Key viewpoints of the project were identified by Noranda and the agencies based on proximity to the project area. Primary roadways and recreation areas were located on maps and then field verified to establish viewpoints that represented a full range of locations and types. Roadways studied include Bear

Creek Road, Ramsey Creek Road, and three viewpoints on Libby Creek Road. Recreation areas and primary visitor destination points investigated included Howard Lake, Horse Mountain Saddle, Great Northern Mountain, Snowshoe Peak, Bald Eagle Peak, and Elephant Peak.

The visual impact assessment for the transmission line incorporated potential impacts from both public lands that are part of the Forest Service Visual Management System and private lands not included in this system. Noranda prepared computer visibility maps to evaluate the potential of seeing the project facilities and alternatives from each identified key viewpoint. Noranda also prepared 3-dimensional computer simulations in order to simulate views of selected proposed project facilities from each key viewpoint. After determining the potential impact, the simulations were combined with site photographs from three viewpoints to depict the changes within the landscape.

Traffic

Methods described in the *Highway Capacity Manual, Special Report No. 209* were used to assess the proposed project's impact on traffic congestion. A Service Flow Rate, which is the maximum hourly traffic volume a roadway can support for a given level of service, for level of service "C" was used. Both morning and afternoon peak traffic periods were analyzed. The following assumptions were made regarding U.S. 2—

- directional distribution of traffic 50 percent in each direction;
- 20 percent traffic allows for no passing;
- a 0.70 adjustment factor for narrow lanes and restricted shoulder width;
- daily traffic volume 2,650 in 1988 and 3,265 in 2008;
- traffic volumes decrease 25 percent between USFS Rd. 278/U.S. 2 and Libby; and
- a 13 percent percent peak hour factor (based on discussions with the Montana Department of Highways).

The following assumptions were made regarding USFS Rd. 278—

- 12-foot traffic lanes, 3-foot shoulder;
- 50 percent no passing in mountainous terrain;
- no severe grades;
- base yearly traffic of 90 vehicles; and
- an annual traffic growth rate of 2 percent, which resulted in a traffic volume of 135 in the year 2008.

The analysis of the U.S. 2/USFS Rd. 278 intersection was conducted for 1992 and for the year 2008. Within each year, both morning and afternoon peak traffic periods were analyzed. The analysis assumed that the intersection was unsignalized.

For Alternative 2, a 50 percent increase in carpooling or ride sharing and mass transit would result in an automobile occupancy rate 1.75. For the day shift, there would be 203 people traveling to the proposed project. The assumption was made that 103 would use mass transit (three buses) and the remaining 100 employees would travel in 57 vehicles. This would result in 60 total vehicle trips—a reduction of 75 vehicle trips. For the swing shift and graveyard shift, 83 vehicle trips would amount to 125 person-trips. The assumption was made that 65 would use mass transit (two buses). The remaining 60 employees would travel in 34 vehicles.

Safety. The change in vehicle miles of travel (VMT) was used as the surrogate for safety. The total accident rate on US 2 near Libby is 1.45 accidents per million VMT (MVMT), and the severe accident rate is 1.41 accidents per MVMT.

Load carrying capacity. The use of equivalent system application loading (ESAL) was used as the measure of the impact to the load carrying capacity of US 2. ESALs were calculated for a 10-year period using the following vehicle mix: passenger cars and pickups, 3 per 1,000 application; single unit trucks,

249 per 1,000 application; combination trucks, 1,087 per 1,000 application.

Cumulative impacts. Using the information on proposed and current timber sales in Chapter 2, a worst case assumption was made that proposed timber sales would result in an additional 15 truck trips per day, or four additional truck trips during peak traffic periods. It was also assumed that all additional truck trips would use USFS Rd. 278.

Socioeconomics

Methods used to collect and analyze baseline socioeconomic data included—

- review of permit application materials;
- discussions with citizens and local officials;
- review of published data by local, state, and federal agencies;
- review of materials being collected by Noranda and its consultants for the Hard Rock Mining Impact Plan; and
- review of information collected during the EIS scoping process.

Date collected were the most currently available as of late 1988; more recent data were provided only where the new data were fundamentally different than 1988 data. Data from the pst also were collected to analyze trends. Surveys, questionnaires and additional primary data gathering efforts were not performed.

Baseline data were combined with project-related data (employment needs and schedule, access to facilities, etc.) to estimate impacts due to proposed project development within each specific impacted jurisdiction. The basis for the methodology used to estimate impacts is the economic base concept, whereby each new basic job generates indirect (or service) employment. In-migrating basic and non-basic employment, plus dependents associated with this employment, were allocated to specific residency areas. Comparison of the population increase to baseline population forms the basis for analysis of the significance of impacts. Once population effects were estimated, effects on community services, facilities, housing and quality of life were determined.

The analysis required the formulation of several assumptions. These are discussed in Chapter 4 where appropriate. Assumptions were determined through review of available data on similar projects and through discussion with local informed parties.

Noise

The STAMINA 2.0 program was used to model traffic noise. The original highway noise prediction computer program was developed under contract to the U.S. Department of Transportation, and published in 1972. The Transportation Systems Center made a few modifications to the program and published a user's manual. After this, the program became one of the Federal Highway Administration's approved traffic noise prediction methods, and the program became known popularly as the "TSC Method" of traffic noise prediction.

The STAMINA 2.0 program performs all of the highway traffic noise prediction. The basic problem considered in the STAMINA code is the estimation of the acoustic intensity at a receiver location resulting from noise generated by traffic on roads. The source characteristics are defined by speed-dependent reference noise emission levels and vehicle density by vehicle type. The geometry is three dimensional. The program considers characteristics of the source-receiver path by including the effects of intervening barriers, topography, trees, and atmospheric absorption.

The calculations of the noise levels along Bear Creek Road and U.S. 2 assumed that there were no topographical barriers between the vehicle and the receivers that would reduce the noise levels. Also, the program included the effect of sound absorption by grass, shrubs and trees between the vehicles and the receivers.

7

CONSULTATION AND COORDINATION

A formal period for submittal of comments on the project and the scope of the EIS occurred prior to preparing the EIS. Notification of the agencies' intention to prepare the EIS and announcement of a period during which public comments would be received regarding the EIS scope was published in the *Federal Register* on July 26, 1989 and in local and area newspapers. A public meeting was held on August 9, 1989 in Libby Montana. This meeting was a key element of the scoping process for this EIS. Several weeks before the meeting, written notice was mailed to nearly 400 people who had expressed an interest in the project. Announcements concerning the meeting and requesting written comments were also made on the local radio station.

The meeting was attended by 154 people, including representatives of each of the four lead agencies and other state and federal agency representatives. During the meeting, attendees were divided into a number of discussion groups of about eight to ten people each. Each discussion group also included an agency representative. A spokesperson for each group was asked to record issues and concerns raised in the group. These were later presented by each spokesperson to the entire meeting. A number of written comments were also received during the scoping process. These were compiled with issues and concerns expressed at the public meeting. All comments are addressed in Chapter 8 of this EIS.

Another meeting was held on February 15, 1990 to discuss Noranda's petition to the Board of Health and Environmental Sciences to change the quality of ambient water. Representatives from the Department of Health and Environmental Sciences explained the issues surrounding the petition and described the decision-making process.

DISTRIBUTION AND REVIEW OF THIS EIS

Copies of this draft EIS are being provided to about 300 persons, groups, local governments, and agencies that have expressed an interest in the

Montanore Project. The mailing list was compiled using the names and addresses of—

- parties who participated in the public meeting or who submitted written comments;
- parties who have requested copies of the EIS;
- agencies, governments, tribes, and companies potentially affected by the proposed operation; and
- agencies and groups consulted during the EIS preparation.

The following agencies, organizations, and people were mailed a copy of this draft EIS—

Federal and State Organizations
Federal Energy Regulatory Commission
Federal Highway Administration
Federal Railroad Administration
Idaho Department of State Lands
Idaho Division of Environmental Quality
Rural Electrification Administration
Soil Conservation Service
U.S. Army Corps of Engineers
U.S. Bureau of Land Management
U.S. Bureau of Mines
U.S. Department of Agriculture
U.S. Department of Labor
U.S. Department of the Interior
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
Bonneville Power Administration
Montana Department of Commerce
Montana Department of Fish, Wildlife and Parks
Montana Department of Highways
Montana Department of Revenue
Montana Governor's Office
Montana Public Service Commission
Montana Secretary of State
Montana State Historic Preservation Office
Confederated Salish-Kootenai Tribe
Kootenai Tribal Council
NW Power Planning Council
Office of Architectural and Environmental Preservation

Federal and State Officials
U.S. Senator Conrad Burns
U.S. Senator Max Baucus
U.S. Representative Patrick Williams
U.S. Representative Ron Marlenee
Senator George McCallum
Senator Eleanor Vaughn
Representative Barry Stang
Representative Paula Darko
Representative M.L. Peterson
Representative Paul Rapp-Svrcek
Lincoln County Commissioners
Sanders County Commissioners

Individuals and Organizations
Tony Adkins
Cameron R. Allen
Thomas J. Allen
American Public Land Exchange
ASARCO, Inc.
Eskil Anderson
Maury Anderson
Martha Christine Archer
Brock Applegate
Donna Aucutt
Larry Ausherman
Briggs and Alice Austin
Dale W. Avery
Tim Babcock
Ed W. Baker
Graeme L., Hazel, and Rose L. Baker
John C. Balla
Boyd Banks
Russell S. Barnes
John Basham
David Baskin
Rick Bass
George Bauan
Brian L. Bauer
Skip Baxter
Lisa Bay
Greg Bechle
Teddye L. Beebe
Raymond Bergroos
G.T. Berlin
Neil Bernardy
David T. Berner
Gene Bernofsky
Phillip K. Bigelow
Merlin Bingham
Bill Bischoff
Brad Black, M.D.
David T. Blackburn
Arthur D. and Dallas T. Bollinger
Norm Bourg
Allen & Juanita Brabham

Effie Bradford
Charles F. Brasen
Jamie Brebner
Chuck Brooks
Deborah Brown
Fred Brown
Jay Brown
Jerry Brown
Larry Brown
Tim Brown
J.L. Browne
Greg Bucell
Wiley and Hedwig Buckner
Pat Bugosh
Bob Bujen
Mark Buntin
Allen Burley
Mr. & Mrs. E.R. Buti
Richard Buti
Cabinet Resource Group
A. Buck Caloo
Camp, Dresser & McKee, Inc.
Jasper Carlton
Ethel Carpio
Loretta E. Carr
Charles Carroll
Cole H. Carter
CBS News
Nancy Chalgren
Champion Lumber Co.
Guy D. Chilson
Charles Clark
Chip Clark
Don Clark
Austin B. Clayton
David Cleveland
John A. Cleveland
Brian L. Cody
Robert B. Cody
Communities for a Great Northwest
Lane Coulston
John M. and Margaret A. Craig
KPAX-TV, Pat Cross
Pat Cross
Frank A. Crowley
Ed Croymons
Rick Crozier
Frank Cuff
Barry Cupp
Clifford E. Dare
Jill Davies
Jerry Davis
James Dean
Pierson Dean
Clinton E. Degenhart
Dan DeShazer
Jack O. and Debra K. DeShazer
L. Destramps
Paul E. Dircksen
J.D. Dixon
Larry Dolezal
Andy Dorrington
B.J. Dorrington
Charles B. Doten
Charley & Maxine Eggleston
Donna Eggleston
Ed Eggleston
Rep. Jim Elliott
Joe Elliot
David Erickson
Terry & Gerri Erskine
Judy Evans
Stan Evans
George and Beverley Faria
Lisa Fairman
Bruce Farling
Derek & Susan Feeback
Melinda Ferrell
J. F. Fennessy, Jr.
Mark Fennessy, Atty.
1st National Bank of Libby
Flathead Electric Cooperative Inc.
Cameron O. Flint
Edward L. Foss
Tom France
Jan Fraser
Maria Fraser
Margaret Friedlander
Brian Gallik
Rob Gaudin
William S. Gear
Ann German
Richard Gertsch
Leo Giacometto
Glenda Gibbs
Steve R. Giles
Todd Gilligan
Sheila K. Glasgow
Daniel R. Gogen
Lenore Goyen
Great Bear Foundation
Bill Green
Stuart Green
Douglas & Susan Griffiths
Frank C. Griner
Cabinet Resource Group
Bob Gruber
Robert Gruber
Bob Guilfoyle
Elizabeth Gupton
Daryl Hagseth
Don Halverson
Brian & Zoe Ann Hanley
William R. and Rita L. Hanley
Barry Hansen
Pat Hanson
Dwight L. Harris
Al Harrison
Wayne Hartly
Wayne Hartmann
Bill Haskins
Ray Hathhorn
Mr. & Mrs. Ray Hathhow
Don L. Hawkins
Brent L. Heath
Susan Hegarty
Linda Helding
Bob Hemming
Janet Henderson
Kirk Henderson
Melvin Hendrick
Cesar Hernandez
Highland Resources, Inc.
Rick Hildebrand
Alice Hill
John E. Hiner
Bob Holiday
John Holt
Richard Huebschman
Russ Hudson
Jerry Hudspeth
Maurice J. Huisentruit
Joe E. Husten
Lewis Hutching
Judy Hutchins
Hydrometrics, Inc.
Jane Iovino
J.B. Jacks
Al Johnson
E.A. (Andy) Johnson
P. Bryan Johnson
James B. Johnson
Steve Johnson
Cedron Jones
Bud Journey

Bill Armstrong, Jr.
Terry Kaiser
M.A. Kaufman
Bill Keis
Richard Kenelty
Dale and Karen Kerkvliet
Don Kern
Rick Kerr
Helen M. Knight
Kootenai Flyfishers
Kootenai Wildlands Alliance
Nancy Kostman
James Kirk Kraft
Richard A. Kulh
Ray & Sharon Kuntz
Robert W. Kusel
Billie and Walter Lambert
Gary A. Lanaley
Ian Lange
Sharon Larson
David Latham
David P. Lauter
Steve Lethrud
Marvin E. and Marsha I. Levert
Howard Lewis
Steven H. and R. Cristine Lewis
Libby Area Chamber of Commerce
Libby Placer Mining Company
Libby Tomorrow
Lincoln County Commissioners
Chris Lind
Kendra Lind
Doris Lindgren
Cliff Linster
Peter Lintern
Sally Loprinzi
Jim Ludwick
Catherine Church Luscher
Elwin Lee and Bonnie M. Manicke
Forrest R. and Atlanta M. Manicke
Harold V. and Elaine K. Manicke
Kenneth L. and Lorraine Manicke
Roy Winston Manicke
Winston V. and Rose Manicke
R.C. Marozzo
Norman D. Martensen
Bill Martin
Kim Matthew
Tom Matthews
Robert McCallum
Mike McCann
Warren McConkey
Rod McElwain
Lee McKinney
Dan McLaughlin
John McLees
Mark & June McMahon
Larry McMaster
Reg McMurdo
Ed McNew
Aileen McSilva
Larry Mehlhoff
Midas Gold Mining and Milling Co.
S. Miller
Mick Mills
Montana Outfitter and Guides Associated
Chris Moon
Wally Moreau
Eileen Morey
Jim R. Morey
Bruce Morris
Jim Morris
Ken Munski
W.O. Murphy
Dan Duce & Kathy Mutz
Howard Myers
Gay Myrhang
Noranda Minerals Corporation
The Nature Conservancy
John L. Neff
Frank A. & Jenny Nelson
Pam Newbern
Lawrence and Leslie Norry
Northwest Mining Association
Dan Nosler
Monique Nykemp
OEA Research, Inc.
Bill O'Brien
John O'Brien
Charles & Charlene O'Neil
Charles H. O'Neil
Lance Olsen
Nicholas E. Oltean
Raymond Ottulich
PRC Environmental Management, Inc.
Ted Pacheco
Juanita Jane Padden
A.J. & M.R. Pajas
Bee Parker
Jack Parker
John & Norma Parker
Ron & Sharon Parker
Mark Pearson
Ken Peterson
J. Chris Pfahl
G.W. Phillion
Gary Phoenix
Paul A. Pierce
C. Phillips Purdy, Jr.
C.K. Presley
Russell R. Price
Protect Park Resources
Art Purdy
Al and Marbie Randall
Jim Rathbun
Raviv & Patricio Associates, Inc.
Penny Ray
Thomas K. & Penny Ray
M.D. Regan
Henry Reatz
Gene Reckin
Janie Redman
Jim Redman
Kenneth M. Reim
Protect Park Resources
Barbara D. Rhodes
Robert L. Richardson
Darlene Riley
Susan Rinehart
Steve Risley
Roger L. Roberson, Jr.
Gary Robert
Gary Roberts
David B. Robig
Michael Roper
Chuck Rose
Charles Roseburg
Frank Rosiejka
George F. and George W. Rouse
Steven Ruffatto
Kippy Rumelhart
Paul Rumelhart
Michael Ruskey
E.T. Ruppel
St. John's Lutheran Hospital, Inc.
Sanders County Commissioners
Sanders County Ledger
Dan Sands
James A. Sands

Denise Saunders
Patrick W. Savage
Al Sawke
Eberhard A. Schmidt
Eugene K. Schmidt
Paul L. Schmidt
James C. and Vicki L. Schneider
Earl Schulke
Otto L. Schumacher
Dyle C. Scott
Herbert C. Scott
James C. Sever
Harvey K., Ethel G., and Mary Jean Shelley
Roger Shields
Bette Shull
Wanda Sidmore
Bruce M. Siefke
Sierra Club Legal Defense Fund
Silver Cable Mining Co.
M. J. Simmins
Henry Skranak
P. Sloan
Howard Smallowitz
Max Smith
Timothy C. Smith
Andy Snyder
Ken Sorensen
John F. Spanfelner
Franklin D. Spencer
Robert & Jean Spooner
John Strohmes
Jackie Stephens
Oalkie Stephens
Heather Stock
Robert Stonehocker
Donna J. Strachocki
Mary Bradshaw and Mary Stranahan
Elizabeth Breyl Strain
Al & Donna Stringer
Deb Strohmyer
Dave Suhr
Darvin Sunde
Larry Sverdrup
Paul Svrcek
John R. Swanson
Thomas M. Sweeney
Mike and Heidy Pelech Switzer
Ed Thompson
Rick Thompson
Chip and Margie Todd
Al Tomlinson
Lee and Carol Tonner
Phil Tosh
Jack Tuholske
Kent Turner, Jr.
U.S. Borax & Chemical Company
A. H. Uithof
Robert Uithof
Susan Ungemach
Mona Vanek
Ben Vaughn
Senator Eleanor L. Vaughn
James D. Vickery
William L. and Susan Vincent
Michael J. and Eileen A. Vivion
Frank Van Vlymen
Mr. & Mrs. Dave Waatt
Eleanor I. Wade
Dan King and Mary Ann Waylett
Harry K. and Nellie Waylett
Genava Manicke Webster
Michael E. Webster
Susan Weller
Joe Welts
Westech, Inc.
Wetern Montana Building and Construction Trades Council
Dorothy Ann White
Mark J. White
Keith Whiting
William Whitmore
Don & Lena Whitson
O.J. Wick
Don Wilkins
Burke Williams
Noel Williams
Dewayne Winthold
Albert F. and Vestina T. Withee
Richard L. Wolden
Connie Wood
Janice Wood
Richard S. Wood
Thomas J. Wood
Charles F. Woods
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8

RESPONSES TO PUBLIC COMMENTS

COMMENTS received during the public meeting and in writing were compiled and reviewed. For most comments, a reference In Table 8-1 is provided which refers the reader to the section in this EIS where the comment is discussed.

Table 8-1. Location in draft EIS of responses to public comments.

Comment	EIS Section	Page No.
Air quality		
What would be the underground air quality? Would silica dust be generated by the operation; would worker health and safety be protected?	Underground air quality is the responsibility of the Mine Safety and Health Administration. It is not discussed in this EIS.	
How would ventilation in the underground mine be handled?	Chapter 2	20
How would the mine exhaust affect the air quality in the Cabinet Mountains Wilderness?	Chapter 4	165
At what point will cumulative impacts be considered and particulate emissions be required to be reduced?	Chapter 4	171
How would blowing dust be controlled?	Chapter 2	54
Cumulative impacts		
What would cumulative impacts be from Noranda's operation and other reasonably foreseeable activities, particularly on water quality and wildlife?	see Cumulative Impact section under each resource in Chapter 4	
Would the proposed project affect the proposed ski area?	See Chapter 2.	93
What is the reasonably foreseeable level of development by other firms of adjacent ore deposits (west, northwest and north of Noranda)?	Chapter 2	88
Monitoring		
Who would conduct the operational and reclamation monitoring?	Chapter 2; Appendix B	56
Who would be responsible for monitoring during temporary closure, and during and following mine closure?	Chapter 2; Appendix B	56
Following mine closure, how long will Noranda be responsible for monitoring and controlling water quality?	Chapter 2	48
Health and safety		
Standards set by the Mine Safety and Health Administration are minimum; can Noranda go one step further?	This issue is the responsibility of the Mine Safety and Health Administration. It is not discussed in this EIS.	
Will Noranda construct a heliport at the plant site for emergencies?	No; a heliport has been constructed at the Libby Creek adit site.	

Table 8-1. Location in draft EIS of responses to public comments (cont'd).

Comment	EIS Section	Page No.
Hydrology/Geotechnical		
Is there any pre-existing contamination from previous mining activity?	Chapter 3	111
Is baseline information submitted by Noranda adequate to assess degradation?	Yes; see Chapter 6	298
What standards would be used to determine degradation?	Chapter 4	185
What would be the source of potable water?	Chapter 2	36
How would wastewater be treated?	Chapter 2	40
How would excess water from the mine be handled?	Chapter 2	36
What provisions are being made to ensure there will be no direct dumping or leaking of contaminants into Ramsey Creek?	Chapter 2	40
How would surface water be routed around the tailings impoundment?	Chapter 2	35
What will prevent Little Cherry Creek from returning to original channel and/or who will maintain diversion?	Chapters 2 and 4	35, 173
What provisions have been made in the design of the impoundment to account for serious mid-winter thaws and extraordinary flood conditions (100 yr. flood)?	Chapter 2 and 4	35, 173
How close is the mine to the wilderness lakes?	Chapter 2	243
Could mine subsidence affect the wilderness lakes?	Chapter 4	175
Would surface runoff from the various facilities affect the surface water quality?	Chapter 4	179
What are the contaminants in the tailings?	Chapter 2	185, 190
How would seepage from the tailings impoundment be monitored?	Chapter 2; also see Appendix B	56, 367
How will surface and ground water quality be monitored; who would do the monitoring?	Chapter 2; also see Appendix B	56, 367
Mine engineering		
What is the relationship of the Libby Creek adit, built on private land, to the overall project?	Chapter 2	30
Are there contingency plans for possible breaks in the transport of tailings?	Chapter 2	33
What would be the estimated mine life?	Chapter 2	20
What provisions are made for increased production due to increased demand or due to more ore being discovered?	Chapter 2	33

Table 8-1. Location in draft EIS of responses to public comments (cont'd).

Comment	EIS Section	Page No.
What are the milling reagents—are any toxic?	Chapters 2 and 4	28, 190
How would the various materials used in the milling process be handled and disposed?	Chapter 2	28, 190
How would hazardous materials be handled and disposed?	Chapter 2	40
Are there any underground storage tanks proposed for the project?	No; see Chapter 2	28
Where will snow go from snow removal operations?	Chapter 2	40
Would there be any subsidence following mining?	Chapter 4	175
Noise		
How much noise would the project generate?	Chapter 4	279
What measures will be taken to minimize noise impact ?	Chapter 4	279
Would the operation be heard in the Cabinet Mountain Wilderness?	Chapter 4	280
Legal		
What legal right does Noranda have to the minerals proposed for mining?	Chapter 1	4
Land use		
What effect would the operation have on recreational, timber harvest, and future multiple use?	Chapter 4	231
What is the possibility of other land use in the drainage as a result of the mine, eg. ski area development.	Chapter 2	93
Reclamation		
How is the size of the reclamation bond determined?	Chapter 1	5
Would the various project components, such as the plant site, tailings impoundment, roads, and transmission line, be reclaimed after the project ends?	Chapter 2	47
What mechanisms would ensure final reclamation?	Chapter 1	7
Recreation		
How would the proposed operation affect recreational opportunities?	Chapter 4	243

Table 8-1. Location in draft EIS of responses to public comments (cont'd).

Comment	EIS Section	Page No.
How will motorized vehicles, bikes, ATV's, etc. be restricted from using the powerline right of way?	Chapter 2	47
How would access to the project area be affected?	Chapter 2	41
Socioeconomics		
Would the existing level of housing and services be adequate to fulfill the increased needs?	Chapter 4	266
How would the general public be affected through demand for local services?	Chapter 4	269
What impacts would the project have on social services, schools and medical facilities?	Chapter 4	266
How many employees would be required by the project and where would the workforce come from?	Chapter 2	47
Will job training be available?	No. Under Alternative 2, Noranda would develop a specific worker training program.	62
What wages and benefits would Noranda pay the employees?	Chapter 2 discusses total payroll. Wage structure is not discussed; wages and benefits are determined individually by private companies.	47
What are the anticipated tax revenues; how will they be apportioned between Lincoln and Sanders Counties?	Chapter 4	269
What are the long term effects on cost of government services, including schools?	Chapter 4	266
Would Noranda compete through a 'company store' or provide other services directly to workers?	No.	
Transportation		
How would the ore concentrate be shipped to Libby?	Chapter 2	33
Where would the rail loadout be located?	Chapter 2	33
How would the transportation of workers and goods affect traffic on Highway 2 and USFS Road 278?	Chapter 4	259
Would Noranda be responsible for road maintenance?	Chapter 2	41
Would project traffic conflict with other types of forest traffic?	Chapter 4	259
Would project traffic affect traffic in Libby?	Chapter 4	259

Table 8-1. Location in draft EIS of responses to public comments (cont'd).

Comment	EIS Section	Page No.
What type and how many access roads are necessary for the powerline?	Chapter 4	225
Visual		
What would the transmission line's visual impact be?	Chapter 4	253
What project components would recreational users see?	Chapter 4	251
Wildlife		
What effect would the proposed operation have on endangered species?	Chapter 4	211
Would mitigation for loss of grizzly bear habitat require closing access to other areas?	Chapter 4	211
What mitigation measures are planned at plant site to minimize noise impact to wildlife?	Chapter 4	279
What will be the effect of the 230 kilovolt powerline on wildlife?	Chapter 4	209
How would increased activity in the project area affect wildlife?	Chapter 4	207

9

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10 GLOSSARY

Adit. A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and unwatered.

Alluvial. Pertaining to material or processes associated with transportation or deposition by running water.

Alluvium. Soil and rock that is deposited by flowing water.

Ambient. Surrounding, existing.

Anticline. A unit of folded strata that is convex upward. In a single anticline beds forming the opposing limbs of the fold dip away from its axial plane.

Bear Management Unit (BMU). A geographic subdivision of Grizzly Bear habitat, which approximates the home range size of a reproductive Grizzly Bear (about 100 square miles in the Cabinet-Yaak ecosystem).

Best Management Practices. Practices determined by the State of Montana to be the most effective and practicable means of preventing or reducing the amount of water pollution generated by non point sources, to meet water quality goals.

Big Game. Those species of large mammals normally managed as a sport hunting resource.

Biological Assessment. An evaluation conducted on Federal projects requiring an environmental impact statement, in accordance with the endangered species act. The purpose of the assessment is to determine whether the proposed action is likely to affect an endangered, threatened, or proposed species.

Borrow Materials. Soil or rock dug from one location to provide fill at another location.

Breached. Said of a folded structure of layered rock which has been eroded to expose at the earth surface the layers that would have otherwise been hidden from view.

Contact Metamorphism. The process by which rocks surrounding an igneous intrusion are changed in

appearance and composition by the heat, pressure and chemicals emanating from that intrusion.

Colluvium. Fragments of rock carried and deposited by gravity.

Drill Seeding. A mechanical method for planting seed in soil.

Endangered Species. Any plant or animal species which is in danger of extinction throughout all or a significant portion of its range. (Endangered Species Act of 1973).

Flotation. A mineral recovery process where individual mineral grains are selectively "floated" and skimmed off the top of an agitated water/chemical bath.

Floodplain. The lowland and relatively flat areas adjoining inland and coastal waters. A 100-year floodplain is that area subject to a one percent or greater chance of flooding in any given year.

Forage. Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forb. Any herbaceous plant other than a grass, especially one growing in a field or meadow.

Freeboard. The distance from surface of a pond to top of a dam.

Glaciofluvial Deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice.

Glaciolacustrine Deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice.

Hydraulic Conductivity. A measure of the ease with which water moves through soil or rock; permeability.

Hydroseeding. Distributing seed in a spray of water. Mulch and fertilizer may be added to the spray.

Igneous. Describes rocks which have formed from the molten state.

Indicator Species. Species of fish, wildlife, or plants which reflect ecological changes caused by land management activities.

Intrude. To forcefully invade and displace pre-existing rocks. Molten rock can inject itself into surrounding rocks due to high temperatures and pressures.

Joint. Fracture in rock, generally more or less vertical or transverse.

Lacustrine. Lake bed sediments.

Liquefaction. When an earthquake occurs, energy released by rupturing in the earth's crust causes cyclic waves to travel through the rock and soil mass. Saturated soils can then experience enough pressure between the individual grains that the soil loses its cohesion (shear strength) and behaves as a liquid.

Macroinvertebrate. Animals without backbones that are visible without a microscope; insects.

Macronutrient. Elements necessary in large amounts for plant growth.

Make-up Water. Water needed to supplement for water removed by the milling process.

Management Area. Geographic areas, not necessarily contiguous, which have common management direction, consistent with the Forest Plan allocations.

Maximum Credible Earthquake. The largest rationally conceivable earthquake that could occur in a particular area.

Mitigation. Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

Old Growth Habitat. Old growth is a distinct successional stage in the development of a timber stand that has special significance for wildlife, generally characterized by: (1) large diameter trees (often exceeding 20 inches dbh) with a relatively dense, often multi-layer canopy. (2) the presence of large, standing dead or dying trees. (3) down, dead trees, (4) stand decadence associated with the presence of various

fungi and heart-rots, (5) an average age often in excess of 200 years, and (6) a basal area ranging from 150 to 400 square feet per acre.

Peak Flow. The greatest flow attained during the melting of the winter snowpack.

Phreatic Surface. The boundary between water saturated and unsaturated soil zone.

Piezometer. A well, generally of small diameter, that is used to measure the elevation of the water table.

Pluton. A body of igneous rock which has intruded beneath the earth's surface. Erosion may later expose these rocks.

Portal. Surface entrance to a mine, particularly to a tunnel or adit.

Potentiometric Surface. The surface or level to which water will rise in a well. The water table is a particular potentiometric surface for an unconfined aquifer.

Probable Maximum Precipitation. The greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographic location at a certain time of the year.

Scoping. The procedures by which the agencies determine the extent of analysis necessary for a proposed action, i.e., the range of actions, alternatives, and impacts to be addressed, identification of significant issues related to a proposed action, and establishing the depth of environmental analysis, data, and task assignments needed.

Seepage Collection System. The system of drains, ponds, and pumps to collect and return tailings dam embankment seepage.

Seismic. Of, or produced by, earthquakes.

Sensitive Species. Those species identified by the Regional Forester for which population viability is a concern as evidenced by significant current or predicted downward trends in (a) population numbers or density, or (b) habitat capability that would reduce a species' existing distribution.

Significant. As used in NEPA, requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

Starter Dam. Earthen dams built of borrow material to initiate construction of the tailings impoundment.

Stratabound. A mineral deposit confined to a single layer, bed or stratum.

Stratigraphy. The arrangement of layered rocks, such as in their chronological order, sequence or geographic position.

Subside. Sink to the bottom; settle. (Subsidence).

Syncline. A unit of folded strata that is concave upward. In a simple syncline, beds forming the opposing limbs of the fold dip toward its axial plane.

Tackifier. An agent that binds seed, fertilizer, and mulch to a site, often used when seeding slopes.

Threatened Species. Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Toe Dam. A small dam located at the base of a larger embankment; usually to collect seepage or runoff.

Total Suspended Solids. Undissolved particles suspended in liquid.

Visual Absorption Capability. The capacity for a landscape to accommodate visual change.

Visual Quality Objective. A classification of six goals or "objectives" for management of the visual resource by the USFS.

ABBREVIATIONS AND ACRONYMS

ARM	Administrative Rules of Montana
BHES	Board of Health and Environmental Sciences
BNRC	Board of Natural Resources and Conservation
BMP	Best Management Practices
BMU	Bear Management Unit
BNRC	Board of Natural Resources and Conservation
BPA	Bonneville Power Administration
CFS	Cubic Feet Per Second
CYE	Cabinet-Yaak Ecosystem
DEIS	Draft Environmental Impact Statement
DHES	Department of Health and Environmental Sciences
DNRC	Department of Natural Resources and Conservation
DSL	Department of State Lands
EPA	Environmental Protection Agency
FWS	Fish and Wildlife Service
KNF	Kootenai National Forest
MCA	Montana Code Annotated
MDFWP	Montana Department of Fish, Wildlife and Parks
MEPA	Montana Environmental Policy Act
MFSA	Major Facility Siting Act
MMBF	Million Board Feet
MNHP	Montana Natural Heritage Program
NEPA	National Environmental Policy Act
ROD	Record of Decision
SHPO	State Historic Preservation Officer
T&E	Threatened and Endangered Species
USFWS	USDI-Fish and Wildlife Service
VAC	Visual Absorption Capability
VQO	Visual Quality Objective
WQB	Water Quality Bureau

11

INDEX

APPENDIX A—REVEGETATION MIXTURES AND RECLAMATION SCHEDULE

Table A-1. Revegetation mixture one.

Species		Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq. ft.
Grasses			
Thickspike wheatgrass	*Agropyron trachycaulum*	2.0	7
Redtop	*Agrostis alba*	0.1	11
Meadow foxtail	*Alopecurus pratensis*	0.75	10
Tufted hairgrass	*Deschampsia cespitosa*	0.25	14
Canada wildryez	*Elymus canadensis*	4.0	10
Tall fescue	*Festuca arundinacea*	2.0	10
Common timothy	*Phleum pratense*[2]	0.25	7
Big bluegrass	*Poa ampla*[3]	0.5	10
Forbs[4]			
Virginia strawberry	*Fragaria virginiana*	1-2	10-20
White clover	*Trifolium repens*		
Beargrass	*Xerophyllum tenax*		
Total		10.85 - 11.85	89-99
Shrubs[5]		Planting Rate (Stems/acre)	
Rocky Mountain maple	*Acer glabrum*		
Sitka alder	*Alnus sinuata*		
Western serviceberry	*Amelanchier alnifolia*		
Red-osier dogwood	*Cornus stolonifera*		
Rusty menziesia	*Menziesia ferruginea*		
Swamp gooseberry	*Ribes lacustre*		
Scouler willow	*Salix scouleriana*		
Sitka mountain ash	*Sorbus sitchensis*		
Total		200	
Trees			
Subalpine fir	*Abies lasiocarpa*	85	
Lodgepole pine	*Pinuis contorta*	85	
Engelmann spruce	*Picea engelmannii*	85	
Douglas-fir	*Pseudotsuga menziesii*	180	
Total		435	

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-55.

[1]Rates given are for drill seeding; rates will be doubled for broadcast seeding.
[2]If commercially available, *Phleum alpinum* will be substituted.
[3]If commercialy available, *Poa alpinum* will be substituted.
[4]Seeding rate given is for a combination of any or all species listed.
[5]Planting rate for shrubs is for a combination of any or all species listed based on site conditions such as aspect, moisture, temperature, etc.

Table A-2. Revegetation mixture two.

Species		Seeding Rate (PLS)[1] Pounds/Acre	PLS/sq. ft.
Grasses			
Streambank wheatgrass	*Agropyron riparium*	3.0	11
Thickspike wheatgrass	*Agropyron trachycaulum*	2.0	7
Redtop	*Agrostis alba*	0.1	11
Mountain brome	*Bromus marginatus*	5.0	10
Orchardgrass	*Dactylis glomerata*	0.5	8
Canada wildrye	*Elymus canadensis*	4.0	10
Sheep fescue	*Festuca ovina*	0.5	8
Common timothy	*Phleum pratense*	0.25	7
Canada bluegrass	*Poa compressa*	0.10	6
Forbs[2]			
Common yarrow	*Achillea millefolium*	1-2	10-20
Pearly everlasting	*Anaphalis margaritacea*		
Fireweed	*Epilobium angustifolium*		
Northern sweetvetch	*Hedysarum boreale*		
Silky lupine	*Lupinus sericeus*		
White clover	*Trifolium repens*		
Total		16.45 - 17.45	88-98
Shrubs[3]		Planting Rate(Stems/acre)	
Barberry	*Berberis repens*		
Snowbrush ceanothus	*Ceanothus velutinus*[4]		
Red raspberry	*Rubus idaeus*		
Scouler willow	*Salix scouleriana*		
White spirea	*Spirea betulifolia*		
Common snowberry	*Symphoricarpos albus*		
Baldhip rose	*Rosa gymnocarpa*		
Huckleberry	*Vaccinium globulare*		
Total		200	
Trees			
Western larch	*Larix occidentalis*	85	
Western white pine	*Pinus monticola*	85	
Lodgepole pine	*Pinus contorta*	85	
Douglas-fir	*Pseudotsuga menziesii*	180	
Total		435	

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-55.

[1]Rates given are for drill seeding; rates will be doubled for broadcast seeding.
[2]Seeding rate given is for a combination of any or all species listed.
[3]Planting rate for shrubs is for a combination of any or all species listed based on site conditions such as aspect, moisture, temperature, etc.
[4]*C. sangineus* may be substituted for *C. velutinus* to assess differences in species performance and wildlife use.

Table A-3. Montanore Project reclamation schedule.

Disturbance	Time in years since first year of production			
	Interim reclamation	Construction period	Operational period	Post-Operational period
Tailings facility				
Impoundment surface	1-16			17-18
Main embankment	1-16			17-18
Toe Dike	-1-14		15-16	
North saddle dam	10-11			17-18
South saddle dam				17-18
Diversion dam		-2		
Diversion channel		-1		
Seepage dam	-1			18+
Seepage pond	-1			18+
Seepage ditches	-1			18+
Borrow area	-1			
Roads (access, haul)	-1			17-18
Soil stockpiles/sites	-2-16			17-18
Water control structures	-1			17-18
Pump station	-1			17-18
Plant site				
Cut/fill slopes		-1		
Patio				17-18
Temporary access road	-1		1	
Soil stockpiles/sites	-1			17-18
Water control structures	-1			17-18
Portals				17-18
Portal patio	-1			17-18
Libby Creek adit area				
Portal				17-18
Patio				17-18
Waste rock dump			-1	
Percolation pond				17-18
Soil stockpile/site	-2			17-18
Water control structures	-2			17-18
Transportation corridors				
Bear Creek access road		-2		
Tailings/plant site corridor	-1			17-18
Powerline corridors	-2			17-18

Source: Noranda Minerals Corp. 1989a. V. 2, p. III-92.

APPENDIX B—MONITORING PROGRAMS

NORANDA and the agencies have developed various environmental monitoring programs which would be implemented in the first quarter of operation of the mill and tailings impoundment and maintained during the life of the project. The interim monitoring plan would be continued up to the time of implementation of the operation monitoring plan. Noranda's interim monitoring program is described in Chapter 2. The objective of the monitoring is to document environmental conditions during operations. Monitoring programs would include surface and ground water hydrology, air quality, fisheries and aquatics, and geotechnical monitoring of the tailings dam and impoundment areas. These programs are described in the following sections.

HYDROLOGY

The monitoring network would include wells to monitor ground water and surface water stations in locations that potentially may be affected by the project. Some of the monitoring locations include locations used during baseline data collection (Chen-Northern, Inc., 1989).

Surface Water

Area streams. Surface water would be monitored for quality and flow in the Ramsey Creek, Little Cherry Creek and Libby Creek drainages. Rock Creek would be monitored for flow. During the baseline study, surface water monitoring stations were established in these drainages to determine baseline conditions and seasonal fluctuations in flow and quality.

Proposed monitoring stations and sampling frequency are shown in Table B-1 and shown in Figure B-1 (the Rock Creek monitoring location, at the outflow of Rock Lake, is not shown on Figure B-1). Seasonal data collection would include early spring low flow, spring high flow, late summer low flow, fall low flow, and winter low flow. The proposed analytical protocol is shown in Table B-2.

Table B-1. Proposed surface water monitoring stations.

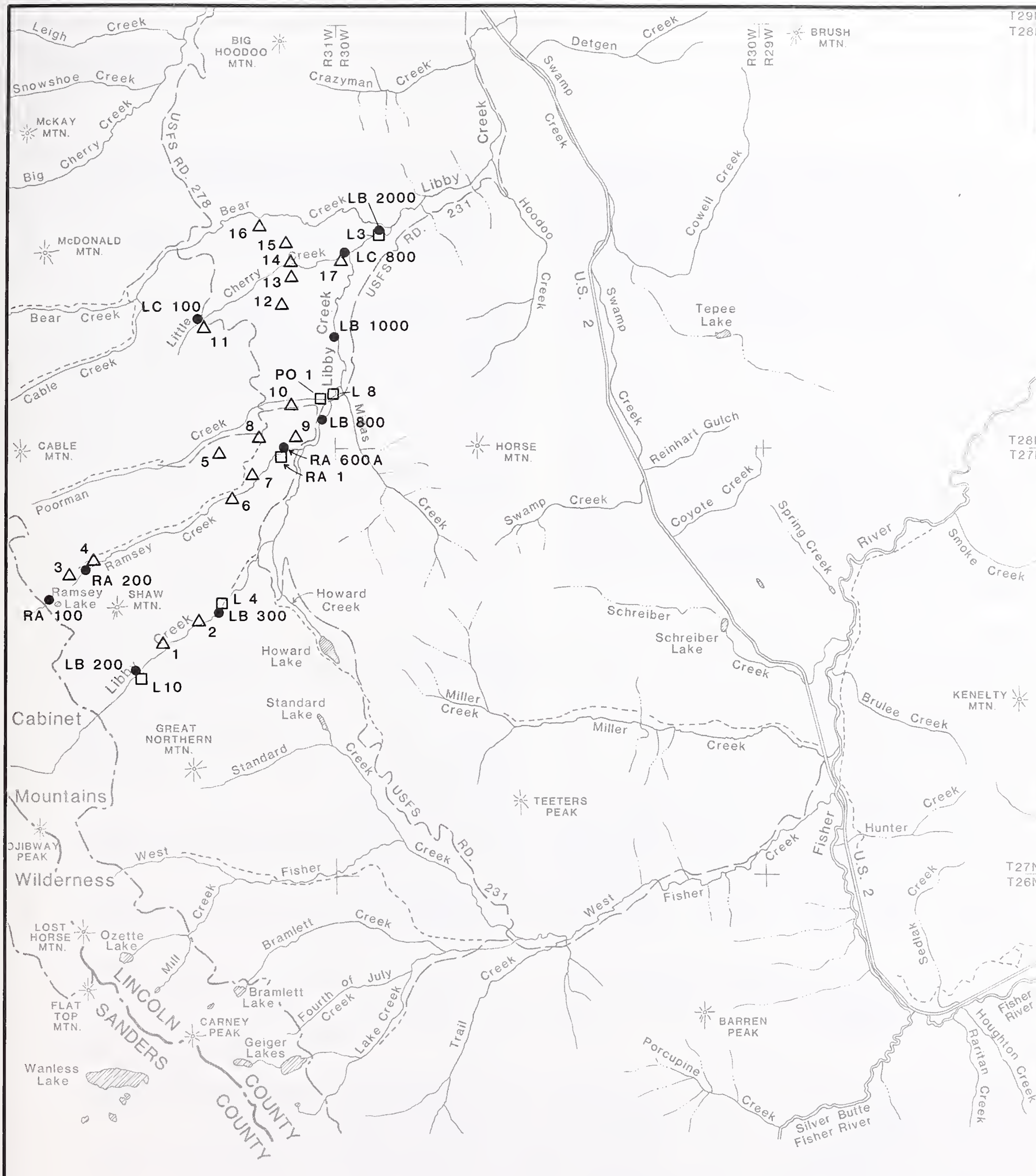
Station	Location	Sampling frequency
Ramsey Creek		
RA 100	Above plant site	Seasonally
RA 200	Below plant site	Seasonally
RA 600A	Just above Libby Creek	Seasonally
Libby Creek		
LB 200	Above adit facilities	Seasonally
LB 300	Below adit facilities	Seasonally
LB 800	Below Ramsey Creek confluence	Seasonally
LB 1000	Above Little Cherry Creek	Seasonally
LB 2000	Below Little Cherry Creek	Seasonally/continuous flow monitoring
Little Cherry Creek		
LC 100	Above tailings impoundment	Seasonally
LC 800	Above Libby Creek	Seasonally
Rock Creek		
RC 100	At outflow of Rock Lake	Continuous flow monitoring only

Source: Hydrometrics, Inc. 1989; revised by the agencies.

Table B-2. Proposed analyses for water resources samples.

Specific conductivity (1.0)†	pH
Total suspended solids (1.0)	Field Temperature (°C)
Total dissolved solids (1.0)	Flow or static water level (wells)
Sodium (1.0)	Total alkalinity (as $CaCO_3$) (1.0)
Calcium (1.0)	Total hardness (as $CaCO_3$) (1.0)
Magnesium (1.0)	Turbidity (0.1)
Potassium (1.0)	Aluminum (0.1)
Carbonate (1.0)	Arsenic (0.005)
Bicarbonate (1.0)	Cadmium (0.0001)
Chloride (1.0)	Chromium (0.02)
Sulfate (1.0)	Copper (0.001)
Nitrite plus nitrate as N (1.0)	Iron (0.05)
Total Kjeldahl nitrogen as N (0.2)	Lead (0.001)
Total phosphorous as P (0.005)	Manganese (0.02)
Ammonia (0.05)	Mercury (0.0002)
	Molybdenum (0.05)
	Silver (0.0002)
	Zinc (0.02)

Source: Hydrometrics, Inc. 1989.
†Proposed analytical detection limits are shown in parentheses in mg/L.



Source: Noranda Minerals Corp. 1989a

LEGEND

- ● Surface Water Monitoring Site
- △ Ground Water Monitoring Site
- □ Aquatic Life Monitoring Site

FIGURE B-1.

PROPOSED OPERATIONAL MONITORING LOCATIONS

NORTH

0 1 2

MILES

Lake levels. Lake levels in Rock Lake, Saint Paul Lake and the southern-most Libby Lake would be monitored. The proposed monitoring program would focus on identifying lake water levels during high and low water level periods. Water levels would be measured from an established level on the lake shore and a photographic record would be obtained.

A datum would be established at each lake by marking a point on a large rock or cliff adjacent to the lake shore. A description and photograph of the datum would be maintained in the monitoring file to allow easy identification and location of the monitoring point. Water levels would be measured relative to the datum with a tape measure, hand level and rod or a fixed staff gage depending on the characteristics of each site.

Water levels would be measured twice each year, once after snow melt and ice break up in June or early July and once during late summer low-water in late August ore September. Water levels relative to the established datum would be recorded in a permanent file and a photograph of the lake shore/datum would be filed with date and location written on the photo. During mine operation, the monitoring frequency would be reevaluated on an annual basis. If substantial inflows to the mine occur in the vicinity of any of the lakes, the need for additional water level monitoring would be evaluated.

Lake water level data would be tabulated and included in the annual hydrologic monitoring report prepared for the project.

Ground Water

Monitoring wells planned for the Montanore Project would include the following—

- Upgradient and downgradient of the plant site on Ramsey Creek and downgradient of proposed water disposal areas adjacent to Ramsey Creek;
- A series of monitoring wells peripheral to the tailings pond including downgradient of the seepage collection pond; and
- Downgradient of the Libby adit portal and water disposal area.

Where appropriately located, ground water monitoring wells used in the baseline investigation would be utilized for operational monitoring. In most areas, new monitoring wells would be needed.

Ground water monitoring locations are shown in Table B-3 and on Figure B-1. Ground water sampling would be conducted at the same time as the surface water sampling.

Water Balance

Noranda would maintain a detailed water balance of inflows and outflows to project facilities. The purpose of the balance would be to provide an assessment of the mine and tailings water inflows and outflows. The monitoring information would be used to modify, as necessary, operational water handling and to develop a post-mining water management plan. As part of this monitoring, Noranda would measure—

- the amount of mine and adit inflows (continuously) and the amount directed to the mill and the amount discharge to percolation ponds;
- the amount of tailings (coarse and fine) slurried to the impoundment and the percent solids of the slurry;
- the amount and source of fresh makeup water used by the mill;
- the amount of reclaimed tailings water sent to the mill;
- the amount of water from the seepage collection pond and the seepage collection/pressure relief wells pumped back to the impoundment;
- the amount of water sent to the enhanced evaporation sprinkler system;
- the amount of water from the tailings impoundment discharged to the percolation ponds, if any;

- the amount of water naturally evaporated at Little Cherry Creek using a pan evaporation technique; and
- the amount of precipitation received at Little Cherry Creek.

These flow measurements would be provided as monthly averages and totals and as an annual average and total and in the annual hydrology report. If sustained mine and adit inflows greater than 1,200 gpm occur or if excessive tailings water occurs or is anticipated, Noranda immediately would notify the agencies. Noranda's excess water contingency plans, described in Chapter 2, would then be implemented. If excess inflows occur near the Rock Lake Fault, Noranda would evaluate the possible connection to surface water bodies, including using appropriate techniques to determine the age of the water.

In conjunction with monitoring of mine and adit inflows, Noranda would collect water samples of inflows on a monthly basis. Water samples would also be collected seasonally (in conjunction with the surface water sampling) of the water collected by the seepage collection system. Samples would be analyzed for the parameters shown in Table B-2. The water quality information would be used to evaluate potential impacts to surface and ground water quality.

Sample Collection and Data Handling

Collection, storage and preservation of water samples would be in accordance with EPA procedures (EPA-600/4-4-82-029). Grab samples would be collected from streams and ground water samples would be obtained with a bailer or a

Table B-3. Proposed ground water monitoring sites.

Site	Location	Sampling frequency
Ramsey Creek drainage		
3	Upgradient of plant site	Seasonally
4	Downgradient of plant site	Seasonally
5	Downgradient of water disposal area 1	Seasonally
6	Downgradient of water disposal area 1	Seasonally
7	Downgradient of water disposal area 1	Seasonally
8	Upgradient of water disposal area 2	Seasonally
9	Downgradient of water disposal area 2	Seasonally
10	Downgradient of water disposal area 2	Seasonally
Libby Creek drainage		
1	Downgradient of adit facilities	Seasonally
2	Downgradient of adit facilities	Seasonally
Little Cherry Creek drainage		
11	Upgradient of tailings impoundment	Seasonally
12	Downgradient of tailings impoundment	Seasonally
13	Downgradient of tailings impoundment	Seasonally
14	Downgradient of tailings impoundment	Seasonally
15	Downgradient of tailings impoundment	Seasonally
16	Downgradient of tailings impoundment	Seasonally
17	Downgradient of seepage collection pond	Seasonally

Source: Hydrometrics, Inc. 1989.

submersible pump. Samples would be cooled immediately after collection. Metals in water samples would be preserved by adding nitric acid in the field to lower the pH to less than 2.0. Ground water samples for metals analysis would be field filtered through a 0.45 micron filter to allow measurement of dissolved constituents. Chemical analysis of water samples would be by procedures described in 40 CFR 136, EPA-600/4-79-020, or methods shown to be equivalent. All field procedures would be consistent with procedures described in the U.S. Geological Survey's National Handbook of Recommended Methods for Water-Data Acquisition.

A specific quality assurance/quality control (QA/QC) program is proposed to guarantee the quality and source of all data collected during the operational monitoring phase of this project. This program includes sample documentation, sample control and data validation and is conformable to the baseline QA/QC program. Specifics of the proposed QA/QC program are presented in Noranda's permit application (Noranda Minerals Corp., 1989a).

The documentation/sample control portion of the QA/QC plan is designed to document and track the samples from the time of collection through reporting of the analytical results. Elements in this portion of the plan include sample identification protocol, the use of standardized field forms to record all field data and activities, and the use of chain-of-custody, sample tracking and analysis request forms. A master file of all field forms and laboratory correspondence would be developed.

The purpose of data validation is to ensure that data collected during the monitoring phase of the Montanore Project is of known and acceptable quality. Identical sample collection and sample analysis methodologies would assure that data collected during the monitoring program would be comparable to baseline data. Representativeness would be ensured by locating sampling stations in representative areas and through the submittal of quality control samples. Quality control samples would include blind field standards, field cross-contamination blanks and replicate samples. Field cross-contamination blanks and replicate samples. Field cross-contamination blanks would be inserted at a minimum frequency of 1 in 20. Blind filed standards and field replicates would be inserted into the sample train at a minimum frequency of 1 in 20. In addition, the use of an EPA-approved laboratory would ensure that laboratory internal QA/QC requirements are also met.

Water quality data generated during the monitoring program would be entered into a computer data base management system after data validation. Protocols outlining data entry/verification, and data security would be developed prior to implementation of the final monitoring plan.

Annual Report

Noranda would prepare an annual report to summarize hydrologic information and data obtained during the year. The report would include data tabulations, maps, cross sections and diagrams needed to clearly describe hydrological conditions.

The data obtained, together with the annual report, would be the basis for an annual review of the suitability of the monitoring program. Based on this review the program may be revised to ensure the appropriate data are collected and that the program is cost effective. Any validated potential impact identified during routine monitoring would be reported immediately to the agencies. Each year Noranda, in coordination with regulatory agencies, would prepare a proposed monitoring program for the Montanore Project after review of all the data from the previous year and review of the overall project data base.

UNDERGROUND GEOTECHNICAL AND GEOCHEMICAL TESTING

Noranda would conduct underground rock mechanics testing to ensure the structural integrity of the mine workings. Specifically, Noranda would

conduct uniaxial compressive testing on ore material to ascertain theoretical strength limits of pillars; conduct tensile tests, primarily on the roof rocks, to determine ultimate opening widths prior to roof failure; and conduct shear tests of roof, floor, and ore rock. Noranda would also conduct micro-seismic monitoring of fracturing in overlying rocks in the mined area to determine the extent of destress fracturing and to verify the Rock Lake Fault and crown barrier pillar thickness required to prevent interception of ground water.

Noranda would conduct chemical analyses on waste rock encountered by the mine adits and in the barren (lead) zone between the ore zones. If the material exhibits acid-generating potential, these materials would be separated from other waste rock for special handling. A detailed handling plan would be developed and submitted to the agencies. Drill samples would be collected from rocks overlying the mine and chemically analyzed to determine if they would be potentially acid generating. This information would be used along with other data to estimate post-mining water quality.

AQUATIC LIFE

Fish and other aquatic organisms are the most sensitive of the uses subjected to adverse impacts by mining in western Montana. Aquatic biomonitoring (1) provides data to assess the ecological integrity of aquatic resources; (2) integrates effects from all pollutant sources, thereby providing measures of cumulative impacts; (3) is inexpensive, relative to extensive chemical monitoring; (4) directly addresses concerns of the public; and (5) can be the only practical means to assess impacts when specific ambient physical or chemical criteria are not available or cannot be defined.

A study plan designed to monitor aquatic bottom dwelling (benthic) insect populations in streams associated with the Montanore Project was provided by Noranda (Western Technology and Engineering, Inc., 1989). The monitoring program objectives are to—

- document the diversity and abundance of macroinvertebrate species present in streams within the project area;
- compare the monitoring data to the baseline macroinvertebrate data; and
- assess the environmental condition of streams within the project area and indicate any significant perturbations.

Monitoring structural changes in benthic insect communities can provide valuable information for assessing potential mine-caused impacts, but a monitoring program that includes only benthic insects can miss significant impacts to other taxonomic groups. This is particularly true for streams, such as those in the Libby Creek drainage, where the benthic communities are frequently and severely stressed naturally by extreme runoff events that flush the streambeds. In addition, the five monitoring stations included in the proposed monitoring program would limit capabilities to identify potential sources of specific mining-related impacts in Libby Creek. Therefore, several modifications and additions are made to the proposed plan for monitoring aquatic life. The goal of this revised monitoring plan would be to evaluate potential impacts and to quantify actual impacts to fish and other aquatic life resulting from construction, operation, and reclamation of the Montanore Project.

Monitoring Locations

Seven stations are proposed for the monitoring program (Table B-4 and Figure B-1). As proposed by Noranda, two stations on Libby Creek, with one upstream (L 10) and one downstream (L 3) of all project activities would provide data from an upstream reference station and from a downstream station having potentially maximum cumulative impacts. Two tributary stations just above the confluences of both Ramsey (Ra 1) and Poorman (Po 1) creeks would monitor potential impacts in

those drainages and a fifth station on Bear Creek (Be 2) would provide data from a non-impacted tributary reference station.

The agencies have revised the monitoring locations. Station Po 1 would be located at its original position in Poorman Creek. Two additional stations would be added to permit better detection of potential impacts to aquatic life in Libby Creek. Besides the new stations, the revised plan would include additional requirements for monitoring benthic insects, periphyton, bioaccumulation of metals by fish, and the acute toxicity of ambient waters.

Benthic Insects

Sample collection of benthic insects would occur during three periods—in April prior to run-off, in August during late summer flows, and in October prior to freeze up. During each sampling at each station, five individual 1-ft^2 areas in riffle and run habitats would be sampled using 500 µm-mesh Suber sampling nets.

Collected samples would be sorted in a laboratory using standard techniques and identified using standard taxonomic references. Data reports would include total numbers of benthic insects; percent relative abundance of four major taxonomic groups (i.e., mayflies, stoneflies, caddisflies, and true midges), for dominant taxa, and for any indicator species; taxonomic richness in each group; diversity index; plus three common statistical indexes (standard deviation, coefficient of variation, and standard error of the mean).

Table B-4. Revised aquatic life monitoring stations

Station	Location	Purpose
Libby Creek		
L 10	Above Libby Creek adit	Upstream Libby Creek reference station
L 4	Relocated to upstream of the Howard Creek confluence	Provide data on which to assess impacts from the Libby Creek adit
L 8	Relocated downstream of Poorman Creek and upstream of Midas Creek	Provide data on which to assess impacts of potential seepages from percolation ponds and cumulative impacts from the Ramsey Creek adit and plant site operations
L 3	Upstream of Bear Creek confluence	Provide data on potential impacts due to seepages from the tailings impoundment plus potential cumulative impacts from all upstream sources
Ramsey Creek		
Ra 1	A new station upstream from the Libby Creek confluence	Assess potential impacts from the Ramsey Creek adit and plant site
Poorman Creek		
Po 1	Upstream from Libby Creek confluence	Assess potential seepages from percolation ponds
Bear Creek Creek		
Be 2	Upstream from any disturbance	Provide reference data from an undisturbed tributary station

Source: Western Technology and Engineering, Inc. 1989; revised by the agencies.

Initial monitoring efforts also would include additional samples and analyses to assure that sampling is adequate to collect all important benthic insect taxa from the stations. Specific approaches for completing this additional analysis are presented by Jackson and Resh (1988). To provide quality control and quality assurance for these studies, Noranda would maintain a taxonomic reference collection containing dominant and indicator benthic species that have been identified by recognized taxonomic experts.

Periphyton

Periphyton is the community of algae that grows attached to rocks and other solid substrates in streams and lakes. Algae are generally the source of most primary production (photosynthesis) in streams. Because of this and because periphyton communities remain at attached locations integrating changes in water quality, many studies have found that periphyton are particularly useful in monitoring and assessing environmental impacts.

Sampling of periphyton populations would be completed at all seven monitoring stations for aquatic life concurrent with the proposed benthic insect population sampling periods in April, August, and October. Methods for periphyton monitoring would follow those used during baseline data collection (Western Resource Development Corp., 1989a). At each station, scrapings of periphyton would be collected from surfaces of stones and other natural substrates, where present, over the range of habitat structures found. The scrapings from each station would be composited and preserved in separate containers. In the laboratory, major periphyton taxa would be identified and counted using standardized methods. Data reports would include lists of the major taxa identified and their relative proportions in each sample at each station. To provide quality control and quality assurance for these studies, Noranda would maintain a reference collection that contains samples of periphyton in which the dominant and any indicator species have been identified by recognized taxonomic experts.

Bioaccumulation of Metals in Fish Tissue

The aquatic baseline studies revealed that various heavy metals have accumulated in fish collected from Station L 3 (also identified as Station LB 1 in the baseline fish survey). These fish were found to contain both mercury and lead (see Fisheries in Chapters 3 and 4).

While other metals were found in fish during these studies, copper, cobalt, and zinc have relatively low bioconcentration factors and are essential micronutrients. Therefore, these metals are of relatively low concern with respect to being sources of risk to potential consumers.

Noranda would continue to monitor potential changes in the concentrations of mercury and lead in fish flesh and skin. For these analyses, 10 rainbow trout greater than five inches in size and 10 adult sculpin would be collected annually from Station L 3 during the late-summer to early-autumn low flow period. Tissue samples using homogenized flesh and skin from each fish would be analyzed to determine lead and mercury concentrations. After at least the first five years of monitoring, it may be possible to focus this analysis effort only on sculpin, if a correlation can be established between their bioconcentration factors for both metals in the rainbow trout and sculpin sampled. This substitution would help reduce sampling loss of rainbow trout from this station, and remove sampling as a possible future contributor causing low population densities of rainbow trout in Libby Creek.

Ambient Stream Water Toxicity

To assess potential toxic impacts to aquatic life, Noranda would monitor the acute toxicity present in ambient waters from three Libby Creek stations and from the proposed percolation pond areas. Water from Station L 3 would be used to assess the toxicity of waters potentially entering the stream through any

subsurface drainages from the percolation pond areas; Station L 4 would provide water for assessing potential toxic inputs for any seepages from the tailings impoundment and from cumulative upstream sources; and samples from Station L 10 would provide reference waters for assessing potential toxicity related to sources upstream of the mine. Waters from this station would also provide dilution waters potentially necessary for completing toxicity tests using samples collected from other stations. Toxicity tests using waters collected from the percolation pond areas would help to establish whether these waters would be a potential source of any toxicity found in ambient stream waters downstream of the ponds.

During pre- and post-operational monitoring, acute toxicity tests would be conducted quarterly using waters from the three stream stations. During mine operations, the monthly acute tests would be required on waters from the three stream stations and from the percolation ponds when in use. Methods used to evaluate acute toxicities would follow those presented by Peltier and Weber (1985), or other methods as current and approved by the Montana Water Quality Bureau.

Initially, acute toxicity testing would routinely employ early life stages of either cutthroat or rainbow trout, depending on their availability, and either *Ceriodaphnia* or *Daphnia*. These four species are generally comparable in their sensitivities to potential metal toxicity. A question remains, however, about the ability to complete successfully either *Ceriodaphnia* or *Daphnia* tests in the very soft waters from the Libby Creek drainage. The very low ionic concentrations in these waters may produce excess ion-regulatory stress and death in these organisms. The pre-operational tests would establish appropriate test protocols for later monitoring studies, and establish whether existing chemical conditions in these creeks are potentially toxic to the test species. The joint tests using both fish and invertebrate species would help to establish the toxicity-response relationship between these species in these test waters. After a satisfactory relationship has been defined, the toxicity tests using fish may be omitted as a future monitoring requirement.

Review of the Monitoring Plan

The monitoring plan for aquatic life includes no consideration of any direct discharge of adit or other treated or untreated mine waters. If any such discharge is included in a future revision of the mine plan, the monitoring plan for aquatic life would be revised.

Results produced by the monitoring plan would be reviewed at 5-year intervals to evaluate possible modifications to the plan. Modifications possible during these reviews could include reductions or additions to the plan. For example, Noranda could be released from required use of fish in the acute toxicity tests. Also, concerns exist about additional undefined impacts related to the diversion of Little Cherry Creek. These concerns may warrant latter establishment of additional monitoring stations on this creek.

AIR QUALITY

Ambient air quality monitoring would be required as a condition of the air quality permit for the project. Monitoring would likely include three to four particulate monitoring sites in the vicinity of the plant and tailings areas and a meteorological monitoring system. All monitoring would be performed according to state and federal quality assurance procedures.

Performance testing (measurement of the particulate emission rate) on the wet scrubber controlling emissions from the surface ore transferring station would also be required to verify compliance with the applicable emission standard (0.05 grams per dry standard cubic meter). Following initial tests, operational parameters of the scrubber would be monitored on an on-going basis. These parameters include scrubbing liquid flow rate and the change in pressure of the gas stream through the scrubber.

Montana Air Quality Bureau personnel would perform on-site inspections of the operation on a random basis on a frequency of about one or two per year. Air monitoring reports would be submitted to the Air Quality Bureau and reviewed on a quarterly basis. The overall effectiveness of the proposed air pollution control measures, with emphasis on the adequacy of wind erosion prevention at the tailings impoundment, would be evaluated on an ongoing basis through monitoring data review and visual observation by Air Quality Bureau and other agencies' personnel.

TAILINGS DAM AND IMPOUNDMENT

The tailings dam stability would be monitored by Noranda both during the operating period and after cessation of mill operations. The monitoring program would consist of visual inspections, piezometer readings, estimates of seepage and topographic surveys. The various aspects of the proposed monitoring are described in detail in the following sections.

The downstream slope and toe of the tailings embankment and saddle, collection and diversion dams (when applicable) would be visually inspected by Noranda on a daily shift basis for evidence of seepage exiting the slope or the downstream toe, and a daily log of observations kept. If seepage is noticed, both the seep location and estimated quantity of flow would be recorded and the project geotechnical engineer immediately contacted for further inspection and recommendation for mitigation measures, if necessary.

If pumps are installed on the seepage collection system, the system would be monitored on a daily shift basis in order to assure proper and continuous operation, and accurate monitoring records would be maintained.

Ground water levels in piezometers installed within the tailings embankment, saddle dam and the dam foundations would be recorded periodically for evaluation of the embankment stability during and after operations. Piezometer monitoring would be performed by Noranda, with monthly readings made during the first five years of operation. After three years, the monitoring schedule would be reevaluated with respect to the ground water levels and a new schedule established.

The primary purpose for monitoring piezometers would be to maintain a record of ground water levels during disposal operations in order to evaluate the slope stability of the embankments. Ground water level data would be plotted on a continuous graph as soon as is practicable after collection, allowing for development of graphs of ground water levels versus time. Trends in ground water level fluctuations which could impact embankment stability would be reviewed by the geotechnical engineer during each monitoring period in order to determine the potential for instability.

Topographic surveys of permanent monuments located on the crest of the tailings dam would be performed semi-annually by Noranda in order to maintain a record of embankment settlement and movements during operations. Accurate records would be kept of both elevations and coordinates of the monuments. In the event of excessive settlements or horizontal movements, the geotechnical engineer would be notified for review of the survey records and recommendations as required.

The depth and/or elevation of the collection pond water level would be recorded on a weekly basis so that estimates of collected seepage can be developed. Accurate records of the quantity of fluid reclaimed from the collection pond and the decant pond would be kept, including pumping rates and periods of pump operation and shutdown.

Annual reports containing all of the monitoring program data along with summaries of the collected data would be prepared by Noranda and submitted to the agencies.

QUALITY ASSURANCE/QUALITY CONTROL

Ongoing environmental monitoring would be conducted for air and water quality, aquatic biology, and tailings dam stability. As part of each protocol for environmental monitoring, distinct quality assurance/quality control (QA/QC) procedures for each of these areas would be developed. Noranda's QA/QC program for hydrology has been described in previous sections. These procedures would collectively comprise a QA/QC plan, the overall goal of which would be to ensure the reliability and accuracy of monitoring information as it is acquired. QA/QC procedures would include both internal and external elements. Internal elements may include procedures for redundant sampling such as random blind splits or other replication schemes, chain of custody documentation, data logging, and error checking. External procedures may include audits and data analyses by outside specialists, and oversight monitoring and data checking conducted by various regulatory agencies.

Written reports to document the implementation of the QA/QC plan would be an integral part of monitoring reports. If variances or exceptions to established sampling or data acquisition methods are detected during monitoring, they would be appropriately documented. These would include a discussion of the significance of data omissions or errors, and measures taken to prevent any re-occurrences. Reports would be submitted as required to the appropriate agencies.

PERFORMANCE STANDARDS AND CORRECTIVE ACTIONS

A fundamental purpose of environmental monitoring would be to document compliance of operations at the Montanore Project with various performance standards dictated by regulatory requirements or by specific permit conditions. Whenever performance standards—such as surface or ground water quality standards—have not been achieved, it would be incumbent upon Noranda to respond with appropriate corrective actions. In certain instances, corrective actions would be proposed by Noranda. In other cases, corrective actions may be dictated by a regulatory agency in a notice of violation or other regulatory action.

AGENCY ROLES AND RESPONSIBILITIES

The agencies would maintain active jurisdiction for overseeing and regulating operations at the Montanore Project, under purview of approvals and permits issued to Noranda by the agencies. A significant part of agency involvement would be in overseeing monitoring and related independent QA/QC activities. As appropriate, agencies would accompany Noranda personnel in the field during sampling episodes both to observe sampling activities and collect sample splits for analysis. Noranda and agency generated data would be reviewed and evaluated, with agencies making determinations with respect to performance standard compliance by Noranda. Noranda would be responsible for the funding of the monitoring programs, including the agencies' QA/QC involvement.

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APPENDIX C— ADDITIONAL FISCAL DATA

Table C-1. Local government finances—Lincoln County.

Category	1979-80 Amount	1979-80 Percent	1985-86 Amount	1985-86 Percent	1986-87 Amount	1986-87 Percent	1987-88 Amount	1987-88 Percent
Taxable Valuation ($000)	$29,138.9	100.0	$36,525.6	100.0	$35,497.2	100.0	$31,276.2	100.0
Land & Improvements	13,127.4	45.1	14,683.1	40.2	14,745.3	41.5	14,277.9	45.7
Centrally Assessed Property	5,739.3	19.7	11,191.6	30.6	10,106.9	28.5	7,319.9	23.4
Personal Property	10,272.2	35.3	10,650.9	29.2	10,645.0	30.0	9,678.4	30.9
Mill Levies	25.84	100.0	44.83	100.0	42.55	100.0	42.53	100.0
General Fund	3.05	11.8	12.38	27.6	9.80	23.0	9.80	23.0
Poor	9.29	36.0	12.00	26.8	12.00	28.2	12.00	28.2
Other	13.50	52.2	20.45	45.6	20.75	48.8	20.73	48.7
All Revenues	$4,034,667	100.0	$6,711,427	100.0	$5,680,163	100.0	$5,786,890	100.0
Property Taxes	759,188	18.8	1,426,917	21.3	1,327,871	23.4	1,350,312	23.3
Transfers	2,497,168	61.9	3,619,533	53.9	2,876,387	50.6	2,753,913	47.6
Other	778,311	19.3	1,664,977	24.8	1,475,905	26.0	1,682,665	29.1
All Expenditures	$3,758,357	100.0	$6,130,355	100.0	$5,612,418	100.0	$5,804,666	100.0
General Government	1,143,337	30.4	1,291,440	21.1	1,461,436	26.0	1,356,003	23.4
Public Safety	608,668	16.2	1,323,134	21.6	1,176,011	21.0	1,253,201	21.6
Public Works	1,273,652	33.9	2,783,189	45.4	2,120,839	37.8	2,396,775	41.3
Public Health	320,042	8.5	342,578	5.6	360,686	6.4	360,654	6.2
Other	412,658	11.0	390,014	6.4	493,446	8.8	438,033	7.5
Population	17,752		19,000		19,000		19,000	
Real Per Capita Expenditures	$212		$323		$295		$306	
General Fund Statistics								
Revenues	$1,211,098		$2,192,063		$1,961,011		$2,246,488	
Expenditures	1,586,413		2,238,709		2,302,864		2,459,181	
Per Capita Expenditures	89		118		121		129	
Expenditures (1987 Dollars)	2,175,070		2,365,542		2,371,486		2,459,181	
Per Capita Expenditures (1987 Dollars)	123		125		125		129	

Source: Economic Consultants Northwest. 1989. p. 24.

Table C-2. Local government finances—Municipality of Libby.

Category	1979-80		1985-86		1986-87		1987-88	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Taxable Valuation ($000)	$3,814.5	100.0	$3,134.2	100.0	$3,220.1	100.0	$3,066.9	100.0
Land & Improvements	2,443.4	64.1	2,295.3	73.2	2,301.5	71.5	2,216.3	72.3
Centrally Assessed Property	567.1	14.9	431.7	13.8	493.8	15.3	428.3	14.0
Personal Property	804.0	21.1	407.2	13.0	424.8	13.2	422.3	13.8
Mill Levies	69.84	100.0	66.10	100.0	66.10	100.0	66.10	100.0
General Fund	40.80	58.4	62.96	95.2	63.10	95.5	64.10	97.0
Streets	16.34	23.4	.00	.0	.00	.0	.00	.0
Other	12.70	18.2	3.14	4.8	3.00	4.5	2.00	3.0
All Revenues	$608,073	100.0	$646,531	100.0	$553,686	100.0	$582,414	100.0
Property Taxes	294,562	48.4	230,153	35.6	272,325	49.2	197,782	34.0
Transfers	102,131	16.8	165,730	25.6	136,827	24.7	135,926	23.3
Other	211,380	34.8	166,021	25.7	144,534	26.1	248,706	42.7
All Expenditures	$593,567	100.0	$485,454	100.0	$593,503	100.0	$609,724	100.0
General Government	57,894	9.8	78,753	16.2	80,773	13.6	89,879	14.7
Public Safety	158,737	26.7	189,678	39.1	200,466	33.8	205,656	33.7
Public Works	123,383	20.8	176,560	36.4	264,831	44.6	268,213	44.0
Other	253,553	42.7	40,463	8.3	47,433	8.0	45,976	7.5
Population	2,748		2,530		2,600		2,600	
Real Per Capita Expenditures	$216		$192		$237		$244	

Source: Economic Consultants Northwest. 1989. p. 27.

Table C-3. Local government finances—Municipality of Troy.

Category	1979-80 Amount	1979-80 Percent	1985-86 Amount	1985-86 Percent	1986-87 Amount	1986-87 Percent	1987-88 Amount	1987-88 Percent
Taxable Valuation ($000)	$700.8	100.0	$724.9	100.0	$731.4	100.0	$670.9	100.0
Land & Improvements	406.9	58.1	415.2	57.3	417.1	57.0	404.4	60.3
Centrally Assessed Property	123.3	17.6	204.6	28.2	198.9	27.2	153.0	22.8
Personal Property	170.6	24.3	105.1	14.5	115.4	15.8	113.5	16.9
Mill Levies	65.00	100.0	85.32	100.0	86.10	100.0	86.17	100.0
General Fund	65.00	100.0	65.00	76.2	65.00	75.5	65.00	75.4
Streets	.00	.0	.00	.0	.00	.0	.00	.0
Other	.00	.0	20.32	23.8	21.10	24.5	21.17	24.6
All Revenues	$95,959	100.0	$154,284	100.0	$188,502	100.0	$149,529	100.0
Property Taxes	48,001	50.0	66,581	43.2	62,633	33.2	60,036	40.2
Transfers	40,888	42.6	47,800	31.0	48,650	25.8	52,782	35.3
Other	7,070	7.4	39,903	25.9	77,219	41.0	36,711	24.6
All Expenditures	$97,942	100.0	$128,519	100.0	$114,011	100.0	$139,051	100.0
General Government	28,864	29.5	53,965	42.0	38,131	33.4	34,606	24.9
Public Safety	40,814	41.7	51,450	40.0	47,744	41.9	50,284	36.2
Public Works	22,143	22.6	20,566	16.0	24,324	21.3	28,677	20.6
Other	6,121	6.2	2,538	2.0	3,812	3.3	25,484	18.3
Population	1,088		1,200		1,200		1,200	
Real Per Capita Expenditures	$90		$107		$95		$116	

Source: Economic Consultants Northwest. 1989. p. 29.

Table C-4. Local government finances—Libby School District #4.

Category	1980-81 Amount	1980-81 Percent	1985-86 Amount	1985-86 Percent	1986-87 Amount	1986-87 Percent	1987-88 Amount	1987-88 Percent
Taxable Valuation ($000)								
Elementary District #4	$16,501.8		$20,627.3		$20,145.6		$19,662.6	
High School District #4	16,501.8		20,627.3		20,145.6		19,662.6	
Mill Levies								
Countywide Levies	68.69	100.0	69.93	100.0	69.36	100.0	69.36	100.0
High School General	25.32	36.9	27.43	39.2	26.16	37.7	27.33	39.4
School General	43.37	63.1	42.50	60.8	43.20	62.3	42.03	60.6
District Levies	103.22	100.0	106.39	100.0	113.79	100.0	113.79	100.0
General Fund	54.19	52.5	50.98	47.9	54.19	47.6	58.79	51.7
Transportation	6.68	6.5	6.82	6.4	7.09	6.2	8.34	7.3
High School	38.24	37.0	43.56	40.9	45.61	40.1	43.28	38.0
Other	4.11	4.0	5.03	4.7	6.90	6.1	3.38	3.0
Elementary District Financial Data								
ANB	1,610		1,504		1,487		1,493	
All Revenues	$3,654,071	100.0	$5,356,436	100.0	$4,858,610	100.0	$5,136,205	100.0
General Fund	3,042,964	83.3	4,158,371	77.6	3,676,075	75.7	3,853,337	75.0
District Levies	1,037,107	34.1	1,102,633	26.5	997,356	27.1	1,078,059	28.0
County Funds	1,133,258	37.2	816,010	19.6	763,200	20.8	729,347	18.9
State Funds	785,228	25.8	2,002,419	48.2	1,677,225	45.6	1,883,149	48.9
Other Funds	87,371	2.9	237,309	5.7	238,294	6.5	162,782	4.2
All Expenditures	$3,578,673	100.0	$5,177,387	100.0	$5,338,736	100.0	$5,364,711	100.0
General Fund	3,007,358	84.0	3,915,874	75.6	4,093,624	76.7	4,001,189	74.6
Transportation	180,733	5.1	254,979	4.9	270,093	5.1	282,355	5.3
Retirement	315,794	8.8	496,019	9.6	515,176	9.6	505,594	9.4
Debt Service	74,788	2.1	48,663	.9	46,914	.9	45,238	.8
Other	0	.0	461,852	8.9	412,929	7.7	530,335	9.9
Per ANB Expenditures	$3,048		$3,637		$3,697		$3,593	

Table C-4. Local government finances—Libby School District #4 (cont'd).

Category	1980-81 Amount	1980-81 Percent	1985-86 Amount	1985-86 Percent	1986-87 Amount	1986-87 Percent	1987-88 Amount	1987-88 Percent
High School District Financial Data								
ANB	795		791		765		754	
All Revenues	$2,173,134	100.0	$3,126,512	100.0	$3,027,902	100.0	$3,051,571	100.0
General Fund	1,836,618	84.5	2,554,201	81.7	2,461,533	81.3	2,409,235	79.0
District Levies	584,735	31.8	811,778	31.8	711,551	28.9	732,363	30.4
County Funds	266,289	14.5	541,671	21.2	507,206	20.6	496,165	20.6
State Funds	954,017	51.9	1,067,976	41.8	1,040,765	42.3	1,035,890	43.0
Other Funds	31,577	1.7	132,776	5.2	202,011	8.2	144,817	6.0
All Expenditures	$2,257,009	100.0	$3,144,841	100.0	$3,168,376	100.0	$3,059,262	100.0
General Fund	1,837,692	81.4	2,533,828	80.6	2,563,732	80.9	2,346,949	76.7
Transportation	106,526	4.7	145,399	4.6	132,609	4.2	124,676	4.1
Retirement	179,118	7.9	264,004	8.4	283,007	8.9	264,120	8.6
Debt Service	86,584	3.8	37,175	1.2	35,775	1.1	34,294	1.1
Other	47,089	2.1	164,435	5.2	153,253	4.8	289,223	9.5
Per ANB Expenditures	$3,892		$4,201		$4,265		$4,057	

Source: Economic Consultants Northwest. 1989. p. 32.

Table C-5. Local government finances—Troy School District #1.

Category	1980-81		1985-86		1986-87		1987-88	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Taxable Valuation ($000)								
Elementary District #1	$4,821.0		$8,942.8		$8,638.1		$8,149.0	
High School District #1	4,861.0		9,719.7		9,547.4		9,046.5	
Mill Levies								
Countywide Levies	68.69	100.0	69.93	100.0	69.36	100.0	69.36	100.0
High School General	25.32	36.9	27.43	39.2	26.16	37.7	27.33	39.4
School General	43.37	63.1	42.50	60.8	43.20	62.3	42.03	60.6
District Levies	155.11	100.0	99.50	100.0	119.10	100.0	108.16	100.0
General Fund	69.49	44.8	29.08	29.2	35.44	29.8	27.04	25.0
Transportation	9.34	6.0	4.34	4.4	9.66	8.1	5.39	5.0
High School	51.97	33.5	43.90	44.1	58.13	48.8	57.83	53.5
Other	24.31	15.7	22.18	22.3	15.87	13.3	17.90	16.5
Elementary District Financial Data								
ANB	384		475		488		467	
All Revenues	$863,584	100.0	$1,715,851	100.0	$1,770,841	100.0	$1,768,535	100.0
General Fund	633,645	73.4	1,130,963	65.9	1,108,040	62.6	1,207,639	68.3
District Levies	195,818	30.9	264,852	23.4	294,631	26.6	229,685	19.0
County Funds	240,986	38.0	247,117	21.9	249,169	22.5	230,071	19.1
State Funds	180,523	28.5	590,347	52.2	536,730	48.4	581,582	48.2
Other Funds	16,318	2.6	28,647	2.5	27,510	2.5	166,301	13.8
All Expenditures	854,991	100.0	1,869,534	100.0	1,706,381	100.0	1,787,467	100.0
General Fund	617,302	72.2	1,047,531	56.0	1,154,469	67.7	1,113,376	62.3
Transportation	46,719	5.5	75,402	4.0	99,936	5.9	87,716	4.9
Retirement	60,925	7.1	134,362	7.2	140,742	8.2	144,806	8.1
Debt Service	86,497	10.1	139,129	7.4	129,552	7.6	124,760	7.0
Other	43,548	5.1	473,110	25.3	181,682	10.6	316,809	17.7
Per ANB Expenditures	3,053		4,159		3,601		3,828	

Table C-5. Local government finances—Troy School District #1 (cont'd).

Category	1980-81		1985-86		1986-87		1987-88	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
High School District Financial Data								
ANB	174		208		208		209	
All Revenues	$601,432	100.0	$1,080,340	100.0	$1,191,635	100.0	$1,248,470	100.0
General Fund	416,027	69.2	815,720	75.5	814,919	68.4	869,810	69.7
District Levies	100,442	24.1	318,583	39.1	317,776	39.0	305,299	35.1
County Funds	66,842	16.1	163,273	20.0	158,673	19.5	158,097	18.2
State Funds	242,924	58.4	306,719	37.6	312,574	38.4	319,406	36.7
Other Funds	5,819	1.4	27,145	3.3	25,896	3.2	87,008	10.0
All Expenditures	$638,894	100.0	$1,076,828	100.0	$1,045,730	100.0	$1,113,087	100.0
General Fund	435,190	68.1	773,091	71.8	805,541	77.0	807,761	72.6
Transportation	59,620	9.3	51,109	4.7	48,235	4.6	58,815	5.3
Retirement	40,625	6.4	79,321	7.4	80,756	7.7	87,092	7.8
Debt Service	36,622	5.7	88,990	8.3	81,007	7.7	79,026	7.1
Other	66,837	10.5	84,317	7.8	30,191	2.9	80,393	7.2
Per ANB Expenditures	5,034		5,470		5,177		5,326	

Source: Economic Consultants Northwest. 1989. p. 36.

Table C-6. Local government finances—Sanders County.

Category	1979-80 Amount	1979-80 Percent	1985-86 Amount	1985-86 Percent	1986-87 Amount	1986-87 Percent	1987-88 Amount	1987-88 Percent
Taxable Valuation ($000)	$19,483.8	100.0	$30,902.8	100.0	$31,401.5	100.0	$29,643.7	100.0
Land & Improvements	4,924.9	25.3	6,157.3	19.9	6,067.0	19.3	6,051.1	20.4
Centrally Assessed Property	10,504.4	53.9	22,657.1	73.3	24,240.3	77.2	21,537.4	72.7
Personal Property	4,054.5	20.8	2,088.4	6.8	1,094.2	3.5	2,055.2	6.9
Mill Levies	39.97	100.0	59.08	100.0	58.57	100.0	57.87	100.0
General Fund	23.75	59.4	24.55	41.6	19.50	33.3	19.50	33.7
Poor	2.44	6.1	5.05	8.5	4.00	6.8	4.00	6.9
Other	13.78	34.5	29.48	49.9	35.07	59.9	34.37	59.4
All Revenues	$1,168,023	100.0	$2,666,610	100.0	$3,234,057	100.0	$3,736,512	100.0
Property Taxes	854,429	73.2	1,224,056	45.9	1,791,752	55.4	1,899,329	50.8
Transfers	178,654	15.3	1,081,981	40.6	895,126	27.7	1,461,784	39.1
Other	134,940	11.6	360,573	13.5	547,179	16.9	375,399	10.0
All Expenditures	$3,758,357	100.0	$2,883,541	100.0	$2,909,392	100.0	$3,861,017	100.0
General Government	1,143,337	30.4	679,780	23.6	733,312	25.2	697,797	18.1
Public Safety	608,668	16.2	416,189	14.4	398,423	13.7	396,670	10.3
Public Works	1,273,652	33.9	1,212,564	42.1	1,216,282	41.8	2,058,659	53.3
Public Health	54,756	1.5	87,582	3.0	88,474	3.0	86,404	2.2
Other	677,944	18.0	487,426	16.9	472,901	16.3	621,487	16.1
Population	8,675		8,900		8,900		8,800	
Real Per Capita Expenditures	$433		$324		$327		$439	
General Fund Statistics								
Revenues	$1,211,098		$850,106		$994,735		$1,009,613	
Expenditures	1,586,413		1,174,814		1,092,697		1,108,945	
Real Per Capita Exp	183		132		123		126	
Expenditures (1988 Dollars)	2,175,070		1,241,373		1,125,258		1,108,945	
Per Capita Expenditures (1988 Dollars)	344		147		130		126	

Source: Economic Consultants Northwest. 1989. p. 55.

THE following photographs are visual simulations of three project facilities—the plant site, the tailings impoundment, and the transmission line.

APPENDIX D—VISUAL SIMULATIONS

FIGURE D-1

VISUAL SIMULATION OF PROPOSED PLANT SITE FROM ELEPHANT PEAK

FIGURE D-2.
VISUAL SIMULATION OF PROPOSED TAILINGS IMPOUNDMENT FROM LIBBY CREEK ROAD

FIGURE [illegible]

VISUAL SIMULATION OF PROPOSED TRANSMISSION LINE FROM HOWARD LAKE CAMPGROUND

APPENDIX E—MANAGEMENT AREA DESCRIPTIONS

As discussed in Chapters 2 and 4, development of the Montanore Project would require amending the KNF Forest Plan. Areas presently classified as corridor avoidance areas that would be crossed by the transmission line would be amended to Management Area 23—Electric Transmission Corridor. The tailings impoundment area would be amended to Management Area 31—Mineral Development. MA 31 would be a new MA on the KNF. The goals and standards for these two MA are described in the following sections. Chapters and appendices refer to those in the Forest Plan (Kootenai National Forest, 1987).

MANAGEMENT AREA 23

Electric Transmisison Corridor

A. DESCRIPTION

This MA is composed entirely of the existing electric transmission corridor on the south end of the Forest which crosses along the south boundary of the Cabinet Mountains Wilderness. There is a low-standard access road providing repair and inspection access for the entire length. Vegetation varies from shrubs to small conifers. Almost all acres are in grizzly bear situation 1 and 2.

B. GOALS

Provide for the transmission of electricity in a safe and efficient manner. Protect the adjacent wilderness character, contribute to the diversity of surrounding wildlife habitat, and provide as much security as possible for the grizzly bear.

C. STANDARDS

1. These standards will also apply to any future corridors which may be located and approved.
2. The Forest-wide a mangement direction included in Chapter II of this plan applies to this MA.

Recreation

1. The VQO is maximum modification.
2. The ROS class is predominantly rural.
3. Over-snow vehicles are allowed when conflicts with big game can be avoided.

Wildlife and Fish

1. Vegetation control will be coordinated with wildlife use to provide forage for winter range at lower elevations.
2. Security for wildlife will be provided by regulating access along the corridor. Regulation may include seasonal closures to all motorized vehicles but powerline maintenance personnel.
3. Any activity in this MA will be required to leave no trash or other grizzly attractant. Standards and guidelines specified in Appendix 8 (Grizzly Management Situation Guidelines) will be applied for all activities on grizzly habitat.
4. Controls will be determined site specifically, but any herbicide used may not enter any water course.

Range

Grazing domestic livestock is permitted on the portions where grazing is also permitted on the adjacent MA.

Timber

1. This MA is not suitable for timber production.
2. Culture and harvest of Christmas trees or other products which can safely be grown and harvested under the powerline is permitted.
3. Harvest units in adjacent MAs should be planned to add visual diversity to the corridor edges.

Soil, Water and Air

1. Soil and Water Conservation Practices will guide the implementation and mitigation of all land disturbing activities.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana State Airshed Group.

3. Public motorized access may be restricted because of the need to control erosion on steep grades.

<u>Mineral and Geology</u>

1. Refer to Forest Standards for locatable minerals. Seasonal restrictions may occur.
2. Seasonal restrictions may be required for oil and gas leases and geophysical activities.
3. Generally, disposal of common minerals will not be permitted.

<u>Facilities</u>

1. The powerline access roads will be open to maintenance crews at all times.
2. Public access may be restricted based on the access restrictions of adjacent MAs.
3. Open roads will be maintained at level 2 or better.
4. Because of some steep grades on access roads, erosion control measures including structures, drainage dips, etc. will be inspected annually and constructed or maintained to prevent soil loss.

<u>Fire</u>

<u>Prescribed Fire</u>

Planned Ignitions—Planned ignitions for disposal of activity fuels or wildlife habitat enhancement are permitted.

Unplanned Ignitions—Unplanned ignitions as prescribed fire are not permitted.

<u>Wildfire</u>

All seasons—All wildfires will be controlled.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade

None planned

Projected - Second Decade

None projected.

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation	A-3, A-5, A-7
Range	D-1, D-2
Human & Comm Dev.	H-3, H-4
Facilities	L-1, L-2

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

MANAGEMENT AREA 31

Mineral Development

A. DESCRIPTION

This MA consists of permitted land areas that are directly involved with mineral production facilities such as major mine portals, mineral ore processing facilities, mineral tailings impoundments, water diversion structures, percolation areas, pipelines, and long-term equipment occupancy areas. They can be located within or adjacent to other MAs, depending on the final approved location of the mine and the necessary supporting facilities.

B. GOALS

Provide for safe and healthful working areas for mineral production workers that are in concert with the surrounding MAs as much as possible. Additional sites for this MA will be provided as demand and successful mineral discoveries permit. The VQO is maximum modification.

C. STANDARDS

1. These standards will apply to all mineral development areas.
2. The Forest-wide management direction included in Chapter II of this plan applies to this MA.

Recreation

1. There is no ROS class associated with this MA.
2. ORV use is not permitted in this MA.

Wildlife and Fish

1. Locate facilities, if possible, away from important winter range, calving areas, riparian areas and meadows.
2. Activities will be scheduled, if possible, to prevent conflict with wildlife use in adjacent MAs, particularly winter range use.
3. Activities will be conducted to prevent siltation in streams that provide spawning habitat for both resident and migratory fish.

Range

Domestic livestock grazing is generally not permitted.

Timber

1. This MA is not suitable for timber production.
2. Salvage harvest may occur to remove trees infested by insects or disease, to remove hazard trees, or for other land clearing necessary for mineral production purposes.
3. Landing areas for timber harvest on adjacent MAs are permitted if there is no conflict with the mineral production facility, soil protection, water quality, or cultural site protection.

Soil, Water and Air

1. Soil and Water Conservation Practices will be followed for any activity.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana Airshed Group.

Riparian (See Riparian Area, Chapter III)

Minerals and Geology

1. Refer to Forest standards for locatable minerals. Seasonal restrictions may occur.
2. Stipulate no surface occupancy for oil and gas leases.
3. Removal of common minerals will generally not be permitted unless it is consistent with the mineral production facility needs.

Lands

Special uses, rights-of-way, easements, or cost-share agreements may be authorized on a case-by-case basis, provided that they are consistent with the mineral production facility.

Facilities

1. Permanent roads are anticipated and will be maintained for safe use.
2. Temporary roads will be closed, drained, and revegetated.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade

None planned

Projected - Second Decade

None projected

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation	A-7
Wildlife and Fish	C-9
Soil and Water	F-1
Minerals	G-1

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

APPENDIX F—DRAFT ENVIRONMENTAL SPECIFICATIONS FOR THE 230-kV TRANSMISSION LINE

DEFINITIONS

ACCESS EASEMENT:	Any land area over which the OWNER has received an easement from a landowner allowing travel to and from the project. Access easements may or may not include access roads.
ACCESS ROAD:	Any travel course which is constructed by substantial recontouring of land and which is intended to permit passage by most four-wheeled vehicles.
BEGINNING OF CONSTRUCTION:	Any project-related earthmoving or removal of vegetation (except for clearing of survey lines).
BOARD:	Montana BOARD of Natural Resources and Conservation
CONTRACTOR:	Constructors of the Facility (agent of owner)
DEWP:	Montana Department of Fish, Wildlife, and Parks
DHES:	Montana Department of Health and Environmental Sciences
DNRC:	Montana Department of Natural Resources and Conservation
DOH:	Montana Department of Highways
DSL:	Montana Department of State Lands
EXEMPT FACILITY:	A facility meeting the requirements of 75-20-202, MCA and accompanying rules.
LANDOWNER:	The owner of private property or the managing agency for public lands
OWNER:	The owner(s) of the facility, or the owner's agent
SENSITIVE AREA:	Area which exhibits environmental characteristics that may make them susceptible to impact from construction of a transmission facility. The extent of these areas are defined for each project but may include any of the areas listed in 36.7.2533 or 36.7.2534 ARM as "sensitive areas" or "areas of concern".
SHPO:	State Historic Preservation Office

PREFACE

For any transmission facility approved by the Board of Natural Resources and Conservation, a set of environmental specifications must be developed jointly by the applicant and DNRC and included in the Certificate of Environmental Compatibility and Public Need.

For a specific project, draft language for those environmental specifications which apply to the entire project is developed prior to publication of the draft EIS. This language is then subjected to public review in the DEIS, revised for the final EIS, and approved by the Board at the time of route approval. Site-specific measures, which cannot be specified until after detailed centerline study, must be included in the Certificate at the time the Board approves a final centerline for the facility.

The purpose of this document is to provide a checklist and suggested language for non-site-specific environmental specifications (items 0.0 through 4.5.2), and a checklist of types of site-specific data which typically need to be worked out during centerline study (Addendums A through P). This approach can greatly facilitate the preparation of a project-specific set of environmental specifications for Board approval. This document has been written to include suggested language for most environmental specifications typically employed to mitigate impacts of transmission lines of all voltages above 100 kV. These specifications are those which DNRC and BNRC have found necessary to ensure environmental protection during construction and operation of transmission facilities. The language included has been carefully worded to be suitable for most projects, but it is anticipated that certain minor modifications will be needed to accommodate a specific project of a certain voltage located in a certain portion of the state. Certain of the measures listed may not apply and may therefore be deleted; additional measures may be added as a result of public and agency involvement. It is intended that this document will be used as the starting point for discussions between an applicant and DNRC in preparing a final set of environmental specifications to be included in the DEIS on a specific project.

A number of site-specific attachments (Addendums A through P) are listed herein; it is intended that language for these attachments will be worked out jointly by DNRC and the applicant during centerline study. The site-specific attachments required for a given project may be quite different from the list suggested in this document and may differ considerably from project to project.

It should be emphasized that this document is merely a suggested starting point for discussion. It has no legal standing and imposes no requirements upon an applicant; legal standing comes about when a revised version of this document is approved by the Board for a specific project certified under MFSA.

INTRODUCTION

The purpose of these specifications is to ensure mitigation of potential environmental impacts during the construction, operation, and maintenance of a transmission facility. These specifications are intended to be incorporated into the texts of contract plans and specifications.

For non-exempt facilities, the Montana Major Facility Siting Act supersedes all state environmental permit requirements except for those dealing with air and water quality, public health and safety, water appropriations and diversions, and easements across state lands (75-20-103 and 401, MCA). A major purpose of these specifications is to ensure that the intent of the laws which are superseded is met, even though the procedures of applying for and obtaining permits from various state agencies are not. As specified later in this document, the State Inspector will have the responsibility for arranging reviews and inspections by other state agencies which would otherwise have been done through a permit application process.

Addendums A through P refer to the site-specific concerns and areas that apply for a specific project. These addendums, as needed, will be prepared by the OWNER working in consultation with the DNRC prior to Board approval of a centerline for a particular project.

0.0 GENERAL SPECIFICATIONS

0.1 Scope

These specifications apply to all lands affected by the project. Where the landowner requests practices other than those listed in these specifications, the OWNER may authorize such a change provided that the STATE INSPECTOR is notified in writing of the change and that the change would not be in violation of: (1) the intent of any state law which is superseded by the Montana Major Facility Siting Act; (2) the Certificate; (3) any conditions imposed by the BOARD; or (4) the BOARD's finding of minimum adverse impact; or (5) the regulations in 36.7.5501 and 5502, ARM.

0.2 Environmental Protection

The OWNER shall conduct all operations in a manner to protect the quality of the environment and to reduce impacts to the greatest extent practical.

0.3 Contract Documents

These specifications shall be part of or incorporated into the contract documents; therefore, the OWNER and the OWNER's agents shall be held responsible for adherence to these specifications in performing the work.

0.4 Briefing Employees

The OWNER shall ensure that the CONTRACTOR and all field supervisors are provided with a copy of these specifications and informed of which sections are applicable to specific procedures. It is the responsibility of the OWNER, its CONTRACTOR, and CONSTRUCTION SUPERVISORS to ensure that the intent of these measures are met. Supervisors shall inform all employees on the applicable environmental constraints spelled out herein prior to and during construction. Site-specific measures spelled out in the addendums attached hereto shall be incorporated into the design and construction specifications or other appropriate contract document.

0.5 Compliance with Regulations

All project-related activities of the OWNER shall comply with all applicable local, state, and federal laws, regulations, and requirements.

0.6 Limits of Liability

the OWNER is not responsible for correction of environmental damage or destruction of property caused by negligent acts of DNRC employees during construction monitoring activities.

0.7 Designation of Sensitive Areas

The DNRC, in its evaluation of the project, has designated certain areas along the right-of-way or access roads as SENSITIVE AREAS. The OWNER shall take all reasonable actions to avoid adverse impact in these SENSITIVE AREAS.

0.8 PERFORMANCE BONDS

To ensure compliance with these specifications, the OWNER shall submit to the State of Montana or its authorized agent a BOND or bonds pertaining specifically to the restoration of the right-of-way and adjacent land damaged during construction. Post-construction monitoring by DNRC will determine compliance with these specifications and other mitigating measures included herein. At the time cleanup and restoration are complete, and revegetation is progressing satisfactorily, the OWNER shall be released from his obligation for restoration. At the time the OWNER is released, a

portion of this BOND or a separate BOND shall be established by the OWNER and submitted to the State of Montana or its authorized agent. This BOND shall be held for five years or until monitoring by DNRC indicates that reclamation and road closures have been adequate. The amount and bonding mechanisms for this section shall be agreed to by the BOARD and OWNER under provisions established by 36.7.4006(2) ARM. The amounts of BOND or BONDS shall be as specified in Addendum B and attached. Proof of bond shall be submitted to DNRC.

0.9 Designation of Structures

Each structure for the project shall be designated by a unique number on plan and profile maps. References to specific poles or towers in Addendums A through P shall use these numbers. If this information is not available because the survey is not complete, locations along the centerline shall be indicated by station numbers or mileposts. Station numbers or mileposts of all angle points shall be designated on plan and profile maps.

0.10 Access

When easements for construction access are obtained for construction personnel, provision will be made by the OWNER to ensure that DNRC personnel will be allowed access to the right-of-way and to any off-right-of-way access roads used for construction during the term of the BOND(s) required by 36.7.4006(2), ARM. Liability for damage caused by providing such access for the STATE INSPECTOR shall be limited by Section 0.6 LIMITS OF LIABILITY.

0.11 Designation of State Inspector

DNRC shall designate a STATE INSPECTOR or INSPECTORS to monitor the OWNER's compliance with these specifications and any other project-specific mitigation measures adopted by the BOARD as provided in 36.7.5502(1), ARM. The STATE INSPECTOR shall be the OWNER's liaison with the State of Montana on construction, post-construction, and reclamation activities. All communications regarding the project shall be directed to the STATE INSPECTOR. The name of the STATE INSPECTOR can be obtained by contacting the Administrator of the Energy Division, DNRC.

1.0 PRECONSTRUCTION PLANNING AND COORDINATION

1.1 Planning

1.1.1 Planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts will be kept to a minimum. The CONTRACTOR and OWNER shall, to the extent possible, plan the timing of construction, construction and maintenance access and requirements, location of special use sites, and other details before the commencement of construction.

1.1.2 Preferable thirty days, but at least fifteen days before the start of construction the OWNER shall submit plan and profile map(s) depicting the location of the centerline and of all construction access roads, maintenance access roads, structures, clearing backlines, and, if known, special use sites. The scale of the map shall be 1:24,000 or larger.

1.1.3 If special use sites are not known at the time of submittal of the plan and profile, the following information shall be submitted no later than five days prior to the start of construction. The location of special use sites including staging sites, pulling sites, batch plant sites, splicing sites, borrow pits, campsites, and storage or other buildings shall be plotted on one of the following and submitted to the Department: ortho photomosaics of a scale 1:24,000 or larger, available USGS 7.5' plan and profile maps of a scale 1:24,000 or larger.

1.1.4 Changes or updates to the information submitted in 1.1.2. and 1.1.3. shall be submitted to the DNRC as they become available. In no case shall

a change be submitted less than five days prior to its anticipated date of construction. Changes in these locations prior to construction (where designated SENSITIVE AREAS are affected), must be submitted to the DNRC 7 days before construction and approved by the STATE INSPECTOR prior to construction.

1.1.5 Long-term maintenance routes to all points on the line should be planned before construction begins. Where known, new construction access roads intended to be maintained for permanent use shall be differentiated from temporary access roads on the maps required under 1.1.2 above.

1.2 Preconstruction Conference

1.2.1 At least one week before commencement of any construction activities, the OWNER shall schedule a preconstruction conference. The STATE INSPECTOR shall be notified of the date and location for this meeting. One of the purposes of this conference shall be to brief the CONTRACTOR and land management agencies regarding the content of these specifications and other BOARD-approved mitigating measures, and to make all parties ware of the roles of the STATE INSPECTOR and of the federal inspectors (if any).

1.2.2 The OWNER's representative, the CONTRACTOR's representative, the STATE INSPECTOR, and representatives of affected state and federal agencies who have land management or permit and easement responsibilities shall be invited to attend the preconstruction conference.

1.3 Public Contact

1.3.1 Written notification by the OWNER's field representative or the CONTRACTOR shall be given to local public officials in each affected community prior to the beginning of construction to provide information on the temporary increase in population, when the increase is expected, and where the workers will be stationed.

1.3.2 The OWNER shall negotiate with the landowner in determining the best locations for access easements, and the need for gates.

1.3.3 The OWNER shall contact local government officials, or the managing agency, as appropriate, regarding implementation of required traffic safety measures.

1.4 Historical and Archaeological Surveys

1.4.1 The OWNER must develop and carry out a plan approved by the State Historic Preservation Office (SHPO) that includes steps which have been and will be taken to identify, evaluate, and avoid or mitigate damage to cultural resources affected by the project. The plan (Addendum I) shall include: (1) actions taken to identify cultural resources during initial intensive survey work; (2) an evaluation of the significance of the identified sites and likely impacts caused by the project; (3) recommended treatments or measures to avoid or mitigate damage to known cultural sites; (4) steps to be taken in the event other sites are identified after approval of the plan; and (5) provisions for monitoring construction to protect cultural resources. Except for monitoring, all steps of the plan must be carried out prior to the start of construction. The requirement for this plan should not be construed to exempt or alter compliance by the OWNER or managing agency with 36 CFR 800. This plan must be filed with SHPO.

2.0 CONSTRUCTION

2.1 General

2.1.1 The preservation of the natural landscape contours and environmental features shall be an important consideration in the location of all construction facilities, including roads, storage areas, and buildings. Construction of these facilities shall be planned and conducted so as to minimize destruction, scarring, or defacing of the natural vegetation and landscape. Any necessary

earthmoving shall be planned and designed to be as compatible as possible with the natural land forms.

2.1.2 Temporary construction sites and staging areas shall be kept to the minimum size necessary to perform the work. Such areas shall be located where most environmentally compatible, considering slope, fragile soils or vegetation, and risk of erosion. After construction,these areas shall be restored as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the STATE INSPECTOR.

2.1.3 All work areas shall be maintained in a neat, clean, and sanitary condition at all times. Trash or construction debris (in addition to solid wasted described in section 2.14) shall be regularly removed during the construction and reclamation periods.

2.1.4 Vegetation such as trees, plants, shrubs, and grass on or adjacent to the right-of-way which do not interfere with the performance of construction work, or operation of the line itself shall be preserved.

2.1.5 The OWNER shall take all necessary action to avoid adverse impacts to SENSITIVE AREAS listed in Addendum A. The STATE INSPECTOR shall be notified two working days in advance of initial clearing or construction activity in these areas. The OWNER shall mark or flag the clearing backlines and limits of disturbance in certain SENSITIVE AREAS as designated in Addendum A. All construction activities must be conducted within this markedarea.

2.1.6 The OWNER shall either acquire appropriate land rights or provide compensation for damage for the land area that will be disturbed by construction. The width of the area disturbed by construction shall not exceed a reasonable distance from the centerline as necessary to perform the work. For this project construction activities should be contained within the area specified in Addendum C.

2.1.7 Flow in a streamcourse may not be permanently diverted. If temporary diversion is necessary, flow will be restored before a major runoff season or the next spawning season, as determined by the STATE INSPECTOR in consultation with the managing agency (see 2.11.6).

2.2 Construction Monitoring

2.2.1 The STATE INSPECTOR is responsible for implementing the monitoring plan required by 36.7.5501(1), ARM. The plan specifies the type of monitoring data and activities required and terms and schedules of monitoring data collection, and assigns responsibilities for data collections, inspection reporting, and other monitoring activities. It is attached as Addendum 0.21

2.22 The STATE INSPECTOR, the OWNER, and the OWNER's agents will rely upon a cooperative working relationship to reconcile potential problems relating to construction in sensitive areas and compliance with these specifications. When construction activities will cause excessive environmental impacts due to seasonal field conditions or encounters with sensitive features, the STATE INSPECTOR will talk with the OWNER about possible mitigating measures or minor construction rescheduling to avoid these impacts. The STATE INSPECTOR will be prepared to provide the OWNER with written documentation of the reasons for the modifications within 24 hours of their imposition.

2.2.3 The STATE INSPECTOR may require mitigation measures or procedures at some sites beyond those listed in Addendum A in order to minimize environmental damage due to unique circumstances that arise during construction, such as unanticipated discovery of a cultural site. The STATE INSPECTOR will follow procedures described in the monitoring plan when such situations arise.

2.2.4 In the event that the STATE INSPECTOR shows reasonable cause that compliance with the BOARD conditions or these specifications is not

being achieved, the DNRC would take corrective action as described in 36.7.5502(9) and (10), ARM.

2.3 Timing of Construction

2.3.1 Construction and motorized travel may be restricted or prohibited at certain times of the year in certain areas. Exemptions to these timing restrictions may be granted by DNRC in writing if the OWNER can clearly demonstrate that no environmental impacts will occur as a result. These areas, listed in Addendum D, include areas deemed as sensitive areas and areas of concern in 36.7.2533 or 36.7.2534 ARM.

2.3.2 In order to prevent rutting and excessive damage to vegetation, construction will not take place during periods of high soil moisture when construction vehicles will cause severe rutting requiring extensive reclamation.

2.4 Public Safety

2.4.1 All construction activities shall be done in compliance with existing health and safety laws.

2.4.2 Requirements for aeronautical hazard marking shall be determined by the OWNER in consultation with the Montana Aeronautical Division, the FAA, and DNRC. These requirements are listed in Addendum E. Where required, aeronautical hazard markings shall be installed at the time the wires are strung, according to the specifications listed an Addendum E.

2.4.3 Noise levels shall not exceed established BOARD standards as a result of operation of the facility and associated facilities. For electric transmission facilities, the average annual noise levels, as expressed by an A-weighted day-night scale (Ldn) will not exceed (a) 50 decibels at the edge of the right-of-way in residential and subdivided areas unless the affected landowner waives this condition, and (b) 55 decibels at the edge of property boundaries of substations in residential and subdivided areas.

2.4.4 The facility shall be designed, constructed, and operated to adhere to the National Electric Safety Codes regarding transmission lines.

2.4.5 The electric field at the edge of the right-of-way will not exceed 1 kilovolt per meter measured 1 meter above the ground in residential or subdivided areas unless the affected landowner waives this condition, and that the electric field at road crossings under the facility will not exceed 7 kilovolts per meter measured 1 meter above the ground.

2.5 Protection of Property

2.5.1 Construction operations shall not take place over or upon the right-of-way of any railroad, public road, public trail, or other public property until negotiations and/or necessary approvals have been completed with the managing agency. Designated recreational trails as listed in Addendum A will be protected and kept open for public use. Where it is necessary to cross a trail with access roads, the trail corridor will be restored. Adequate signing and/or blazes will be established so the user can find the route. All roads and trails designated by government agencies as needed for fire protection or other purposes shall be kept free of logs, brush, and debris resulting from operations under this agreement. Any such road or trail damaged by this project shall be promptly restored as nearly as possible to its original condition.

2.5.2 Reasonable precautions shall be taken to protect, in place, all public land monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, the marker shall be re-established and referenced in accordance with the procedures outlined in the "Manual of Instruction for the Survey of the Public Land of the United States" or, in the case of private property, the specifications of the county engineer. Re-establishment will be at the expense of the OWNER.

2.5.3 Construction shall be conducted so as to prevent any damage to existing real property

including transmission lines, distribution lines, telephone lines, railroads, ditches, and public roads crossed. If such property is damaged by operations under this agreement, the OWNER shall repair such damage immediately to a reasonable satisfactory condition in consultation with the property owner.

2.5.4 In areas with livestock, the OWNER shall make a reasonable effort to comply with the reasonable requests of landowners regarding measures to control livestock. Care shall be taken to ensure that all gates are reclosed after entry or exit and the landowner shall be compensated for any losses to personal property due to construction or maintenance activities. Gates shall be inspected and repaired when necessary during construction and missing padlocks shall be replaced. The OWNER shall ensure that gates are not left open at night or during periods of no construction activity. Any fencing or gates cut, removed, damaged, or destroyed by the OWNER shall immediately be replaced with new materials. Fences installed shall be of the same height and general type as the fence replaced or nearby fence on the same property, and shall be stretched tight with a fence stretcher before stapling or securing to the fence posts. Temporary gates shall be of sufficiently high quality to withstand repeated opening and closing during construction, to the satisfaction of the landowner.

2.5.5 The CONTRACTOR must notify the OWNER, the STATE INSPECTOR, and, if possible, the affected landowner within two working days damage to land, crops, property, or irrigation facilities, contamination or degradation of water, or livestock injury caused by the OWNER's construction activities, and the OWNER shall reasonable restore any damaged resource or property or provide reasonable compensation to the affected party.

2.5.6 Pot holes and anchor holes must be covered or fenced in any fields, pastures, or ranges used for livestock grazing or where a landowner's requests can be reasonably accommodated.

2.5.7 When requested by the landowner, all fences crossed by permanent access roads shall be provided with a gate. All fences to be crossed by access roads shall be braced before the fence is cut. Fences not to be gated should be restrung temporarily during construction and permanently within 30 days following construction, subject to the reasonable desires of the landowner.

2.5.8 Where new access roads cross fence lines, the OWNER shall make reasonable effort to accommodate the landowner's wishes on gate location and width.

2.5.9 Any breaching of natural barriers to livestock movement by construction activities will require fencing sufficient to control livestock.

2.6 Traffic Control

2.6.1 At least 30 days before any construction within or over any state or federal highway right-of-way, the OWNER will notify the appropriate DOH field office to review the proposed occupancy and to resolve any problems. The OWNER must supply DNRC with documentation that this consultation has occurred This documentation should include any measures recommended by DOH and to what extent the OWNER has agreed to comply with these measures. In the event that recommendations or regulations were not followed, a statement as to why the OWNER chose not to follow them should be included.

2.6.2 In areas where the construction created a hazard, traffic will be controlled according to the applicable DOH regulations. Safety signs advising motorists of construction equipment shall be placed on major state highways, as recommended by DOH. The installation of proper road signing will be the responsibility of the OWNER.

2.6.3 The managing agency shall be notified, as soon as practicable, when it is necessary to close public roads to public travel for short periods to provide safety during construction.

2.6.4 Construction vehicles and equipment will be operated at speeds safe for existing road and traffic conditions.

2.6.5 Traffic delays will be restricted on primary access routes, as determined by the DOH or the managing agency.

2.6.6 Access for fire and emergency vehicles will be provided for at all times.

2.6.7 Public travel through and use of active construction areas shall be limited at the discretion of the managing agency.

2.7 Access Roads and Vehicle Movement

2.7.1 Construction of new roads shall be held to the minimum reasonably required to construct and maintain the facility. State, county, and other existing roads shall be used for construction access wherever possible. Access roads intended to be permanent should be initially designed as such. The location of access roads and towers shall be established in consultation with affected landowners and landowner concerns shall be accommodated where reasonably possible and not in contradiction to these specifications or other BOARD conditions.

2.7.2 All new roads, both temporary and permanent, shall be constructed with the minimum possible clearing and soil disturbance to minimize erosion, as specified in Section 2.11 of these specifications.

2.7.3 Where practical, all roads shall be initially designed to accommodate one-way travel of the largest piece of equipment that will eventually be required to use them; road width shall be no wider than necessary.

2.7.4 Roads shall be located in the right-of-way insofar as possible. Travel outside the right-of-way to enable traffic to avoid cables and conductors during conductor-stringing shall be kept to the minimum possible. Road crossings of the right-of-way should be near support structures.

2.7.5 Where practical, temporary roads shall be constructed on the most level land available. Where temporary roads cross flat land they shall not be graded or bladed unless necessary, but will be flagged or otherwise marked to show their location and to prevent travel off the roadway.

2.7.6 In order to minimize soil disturbance and erosion potential, no cutting and filling for access road construction shall be allowed in areas of up to 5 percent sideslope. In areas of over 5 percent sideslope, road building that may be required shall conform to a 4 percent outslope. The roads shall be constructed to prevent channeling of runoff, and shoulders or berms that would channel runoff shall be avoided.

2.7.7 The OWNER will maintain all permanent access roads, including drainage facilities, which are constructed for use during the period of construction. In the event that a road would be left in place, the OWNER and landowner may enter agreements regarding maintenance for erosion control following construction.

2.7.8 Any use damage to existing private roads, including rutting, resulting from construction operation shall be repaired and restored to condition as good or better than original as soon as possible. Repair and restoration should be accomplished during and following construction as necessary to reduce erosion.

2.7.9 All permanent access road surfaces, including those under construction, will be prepared with the necessary erosion control practices as determined by the STATE INSPECTOR or the managing agency prior to the onset of winter.

2.7.10 Any necessary snow removal shall be done in a manner to preserve and protect road signs, and culverts, to ensure safe and efficient transportation, and to prevent excessive erosion damage to roads, streams, and adjacent land.

2.7.11 At the conclusion of line construction, final maintenance will be performed on all existing private

roads used for construction access by the CONTRACTOR. These roads will be returned to a condition as good or better than when construction began.

2.7.12 At least 30 days prior to construction of a new access road approach intersecting a state or federal highway, or of any structure encroaching upon a highway right-of-way, the OWNER shall submit to DOH a plan and profile map showing the location of the proposed construction. At least five days prior to construction, the OWNER shall provide the STATE INSPECTOR written documentation of this consultation and actions to be taken by the OWNER as provided in 2.6.1.

2.8 Equipment Operation

2.8.1 During construction, unauthorized cross-country travel and the development of roads other than those approved shall be prohibited. The OWNER shall be liable for any damage, destruction, or disruption of private property and land caused by his construction personnel and equipment as a result of unauthorized cross-country travel and/or road development.

2.8.2 To prevent excessive soil damage in areas where a graded roadway has not been constructed, the limits and locations of access for construction equipment and vehicles shall be clearly marked or specified at each new site before any equipment is moved to the site. Construction foremen and personnel should be well versed in recognizing these markets and shall understand the restriction on equipment movement that is involved.

2.8.3 Dust control measures shall be implemented on access roads where required by the managing agency or where dust would pose a nuisance to residents. Construction activities and travel shall be conducted to minimize dust. Water, straw, wood chips, dust palliative, gravel, combinations of these, or similar control measures may be used. Oil or similar petroleum-derivatives shall not be used.

2.8.4 Work crew foremen shall be qualified and experienced in the type of work being accomplished by the crew they are supervising. Earthmoving equipment shall be operated only by qualified, experienced personnel. Correction of environmental damage resulting from operation of equipment by inexperienced personnel will be the responsibility of the OWNER. Repair of damage to a condition reasonably satisfactory to the landowner, managing agency, or, if necessary, DNRC, would be required.

2.8.5 Sock lines will be strung using methods which minimize disturbance of soils and vegetation.

2.8.6 Following construction in areas designated by the local weed control board as noxious weed areas the CONTRACTOR shall thoroughly clean all vehicles and equipment to remove weed parts and seeds immediately prior to leaving the area.

2.9 Right-of-Way Clearing and Site Preparation

2.9.1 The STATE INSPECTOR shall be notified at least ten days prior to any timber clearing. The STATE INSPECTOR shall be responsible for notifying the DSL Forestry Division.

2.9.2 During clearing of survey lines or the right-of-way, shrubs shall be preserved to the greatest extent possible. Shrub removal shall be limited to crushing where possible or cutting where necessary. Plants may be cut off at ground level, leaving roots undisturbed so that they may resprout.

2.9.3 Right-of-way clearing shall be kept to the minimum necessary to meet the requirements of the National Electric Safety Code. Trees to be saved within the clearing backlines and danger trees located outside the clearing backlines shall by marked. Clearing backlines in SENSITIVE AREAS will be indicated on plan and profile maps. All snags and old growth trees that do not endanger the line or maintenance equipment shall be preserved. In designated SENSITIVE AREAS, the STATE INSPECTOR shall approve clearing boundaries prior to clearing.

2.9.4 In no case should the entire nominal width of the right-of-way be cleared of trees up to the edge, unless approved by the STATE INSPECTOR and the landowner. Clearing should instead produce a "feathered edge" right-of-way configuration, where only specified hazard trees and those that interfere with construction or conductor clearance are removed. In areas where there is potential for long tunnel views of transmission lines or access roads as described in Addendum A, special care shall be taken to screen the lines from view. Where appropriate, special care shall be taken to leave a separating screen of vegetation where the right-of-way parallels or crosses highways and rivers.

2.9.5 During construction, care will be taken to avoid damage to small trees and shrubs on the right-of-way that do not interfere with the clearing requirements under 2.9.3 and would not grow to create a problem over a ten-year period.

2.9.6 Soil disturbance and earthmoving will be kept to a minimum.

2.9.7 The OWNER shall be held liable for any unauthorized cutting, injury or destruction to timber whether such timber is on or off the right-of-way.

2.9.8 Unless otherwise requested by the landowner or managing agency, felling shall be directional in order to minimize damage to remaining trees. Maximum stump height shall be no more than 12 inches on the uphill side or 1/3 the tree diameter, whichever is greater. Trees will not be pushed or pulled over. Stumps will not be removed unless they conflict with a structure, anchor, or roadway.

2.9.9 Special logging, clearing, or excavation techniques may be required in certain highly sensitive or fragile areas.

2.9.10 Crane landings shall not be constructed on level ground unless extreme conditions (such as soft or marshy ground) make such construction necessary. In areas where more than one crane landing per tower site would be built, the STATE INSPECTOR will be notified at least 5 days prior to the beginning of construction at those sites.

2.9.11 No motorized travel on, scarification of, or displacement of talus slopes shall be allowed except where approved by the STATE INSPECTOR and landowner or managing agency.

2.9.12 To avoid unnecessary ground disturbance, counterpoise should be placed or buried in disturbed areas whenever possible.

2.9.13 Slash resulting from project clearing that may be washed out by high water the following spring shall be removed and piled outside the floodplain before runoff. Instream slash resulting from project clearing must be removed within 24 hours.

2.9.14 Streamside trees will be felled away from streams rather than into or across streams.

2.10 Grounding

Grounding of fences, buildings, and other structures on and adjacent to the right-of-way shall be done according to the specifications of the National Electric Safety Code.

2.11 Erosion and Sediment Control

2.11.1 Clearing and grubbing for roads and rights-of-way and excavation for stream crossings shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. Sediment retention basins will be installed as required by the STATE INSPECTOR or managing agency.

2.11.2 Roads shall cross drainage bottoms at sharp or nearly right angles and level with the streambed whenever possible. Temporary bridges, fords, culverts, or other structures to avoid stream bank damage will be installed.

2.11.3 Under no circumstances shall streambed materials be removed for use as backfill,

embankments, road surfacing, or for other construction purposes.

2.11.4 No excavations shall be allowed on any river or perennial stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

2.11.5 Installation of culverts, bridges, or other structures in perennial streams will be done with normal construction procedures following on-site inspections with DNRC and DFWP. All culverts shall be installed with the culvert inlet ant outlet at natural stream grade or ground level. Water velocities or positioning of culverts shall not impair fish passage.

2.11.6 Construction of access roads, bridges, fill slopes, culverts, or impoundments, or channel changes within the high-water mark of any perennial stream, lake, or pond, requires consultation with DFWP and local conservation district and application of applicable water quality standards. Within 15 days prior to start of construction, the OWNER shall submit written documentation that consultation has occurred. Included in this documentation should be the recommendation of the agencies consulted and the actions that OWNER expects to take to completely implement them.

2.11.7 No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to protect the stream from debris and from entry of nitrates or other contaminants in the stream.

2.11.8 The OWNER shall maintain private roads while using them. All ruts made by machinery shall be filled or graded to prevent channeling. In addition, the OWNER must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include but are not limited to, installing or using cross logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these.

2.11.9 The OWNER shall prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep excavated materials and other extraneous materials out of watercourses. Any such materials entering watercourses shall be removed immediately.

2.11.10 The OWNER shall be responsible for the stability of all embankments created during construction. Embankments and backfills shall contain no stream sediments, frozen material, large roots, sod, or other materials which may reduce their stability.

2.11.11 Culverts, arch bridges, or other stream crossing structures shall be installed at all permanent crossings of flowing or dry watercourses where fill is likely to wash out during the life of the road. Culvert or bridge installation is prohibited in areas of important fish spawning beds identified by MDFWP and during specified fish spawning seasons on less sensitive streams or rivers. All culverts shall be big enough to handle approximately 15-year floods. Culvert size shall be determined by standard procedures which take into account the variations in vegetation and climatic zones in Montana, the amount of fill, and the drainage area above the crossing. All culverts shall be installed at the time of road construction.

2.11.12 No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

2.11.13 No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads.

2.11.14 No perennial watercourses shall be permanently blocked or diverted.

2.11.15 Skidding with tractors shall not be permitted within 100 feet of streams containing flowing water except in places designed in advance, and in no event shall skid roads be located on these streamcourses. Skid trails shall be located high enough out of draws, swales, and valley bottoms to permit diversion of runoff water to natural undisturbed forest ground cover.

2.11.16 Construction methods shall prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Catchment basins capable of containing the maximum accidental spill shall be installed at areas where fuel, chemicals or oil are stored. Any accidental spills of such materials shall be cleaned up immediately.

2.11.17 To reduce the amount of sediment entering streams, a strip of undisturbed vegetation will be provided between areas of disturbance (road construction or tower construction) and streamcourses, and around first order or larger streams that have a well-defined streamcourse or aquatic or riparian vegetation, unless otherwise required by the landowner. Buffer strip width is measured from the high water line of a channel and will be as determined by the STATE INSPECTOR and managing agency. For braided streams with more than one discernible channel (ephemeral or permanent) the high water line of the outermost channel is used. In the event that vegetation cannot be left undisturbed, structural sediment containment, approved by the STATE INSPECTOR, must be substituted before soil disturbing activity commences.

2.11.18 When no longer needed, all temporary structures or fill installed to aid stream crossing shall be removed and the course of the stream re-established to prevent future erosion.

2.11.19 All temporary dams built on the right-of-way shall be removed after line construction unless otherwise approved by the STATE INSPECTOR. Dams allowed to remain shall be upgraded to permanent structures and shall be provided with spillways or culverts and with a continuous sod cover on their tops and downstream slopes. Spillways may be protected against erosion with riprap or equivalent means.

2.11.20 Damage resulting from erosion or other causes shall be repaired after completion of grading and before revegetation is begun.

2.11.21 Point discharge of water will be dispersed in a manner to avoid erosion or sedimentation of streams.

2.11.22 Riprap or other erosion control activities will be planned based on possible downstream consequences of activity, and during the low flow season if possible.

2.11.23 Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete life cleanup, and other waste water processes shall not be discharged into surface waters without a valid discharge permit from DHES.

2.12 Archaeological, Historical and Paleontological Resources

2.12.1 All construction activities shall be conducted so as to prevent damage to significant archaeological, historical, or paleontological resources.

2.12.2 Any relics, artifacts, fossils or other items of historical, paleontological, or archaeological value shall be preserved in a manner agreeable to both the landowner and the State Historic Preservation Officer. If any such items are discovered during construction, SHPO shall be notified immediately. Work which could disturb the materials or surrounding area must cease until the site can be properly evaluated by a qualified archaeologist (ether employed by the OWNER or representing SHPO) and recommendations made by that person based on the Historic Preservation Plan. For significant sites, recommendations of the State Historic Preservation Officer must be followed by the OWNER.

2.12.3 The OWNER shall conform to treatments recommended for cultural resources by either the Montana State Historic Preservation Office (SHPO) or the Advisory Council on Historic Preservation (ACHP).

2.13 Prevention and Control of Fires

2.13.1 Burning, fire prevention, and fire control shall comply with the burning plan and fire plan. These plans shall meet the requirements of the managing agency and/or the fire control agencies having jurisdiction. The STATE INSPECTOR shall be invited to attend all meetings with these agencies to discuss or prepare these plans. The STATE INSPECTOR, in turn, shall notify DSL of all such meetings.

2.13.2 The OWNER shall direct the CONTRACTOR to comply with regulations of any county, town, state or governing municipality having jurisdiction regarding fire laws and regulations.

2.13.3 Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

2.13.4 The OWNER shall direct the CONTRACTOR to properly store and handle combustible material which could create objectionable smoke, odors, or fumes. The OWNER shall direct the CONTRACTOR not to burn refuse such as trash, rags, tires, plastics, or other debris, except as permitted by the county, town, state, or governing municipality having jurisdiction.

2.14 Waste Disposal

2.14.1 The OWNER shall direct the CONTRACTOR to use licensed solid waste disposal sites. Inert materials (Group III wastes) may be disposed of at Class III landfill sites; mixed refuse (Group II wastes) must be disposed of at Class II landfill sites.

2.14.2 Emptied pesticide containers or other chemical containers must be triple rinsed to render them acceptable for disposal in Class II landfills or for scrap recycling pursuant to ARM 16.44.202(12) for treatment or disposal. Pesticide residue and pesticide containers shall be disposed of in accordance with ARM 16.20.633(9).

2.14.3 All waste materials constituting a hazardous waste defined in ARM 16.44.303, and wastes containing any concentration of polychlorinated biphenlyls must be transported to an approved designated hazardous waste management facility (as defined in ARM 16.44.202(12) for treatment or disposal.

2.14.4 All used oil shall be hauled away and recycled or disposed of in a licensed Class II landfill authorized to accept liquid wastes or in accordance with 2.14.2 and 2.14.3. above. There shall be no intentional release of crankcase oil or other toxic substances into streams or soil. In the event of an accidental spill into a waterway, the substances will be cleaned up and the Water Quality Bureau, DHES, will be contacted immediately.

2.14.5 Sewage shall not be discharged into streams or streambeds. The OWNER shall direct the CONTRACTOR to provide refuse containers and sanitary chemical toilets, convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local health laws and regulations.

2.14.6 In order to reduce fire hazard, small trees and brush cut during construction should be chipped, burned, and/or scattered. Slash 3 inches in diameter or greater may be scattered in quantities of up to 15 tons/acre unless otherwise requested by the landowner. Tops, limbs and brush less than 3 inches in diameter and 3 feet in length may be left in quantities less than 3 tons per acre except on cropland and residential land or where otherwise specified by the landowner. In certain cases the STATE INSPECTOR will authorize chipping and scattering of tops, limbs and brush in excess of 3 tons per acre as an erosion control measure. Merchantable timber should be decked and removed

at the direction of the landowner or managing agency.

2.14.7 Refuse burning shall require the prior approval of the landowner and a Montana open Burning Permit must be obtained from MDHES.

2.15 Special Measures

2.15.1 Poles with a low reflectivity constant should be used to reduce potential for visual contrast.

2.15.2 Crossings of rivers should be at right angles. Strategic placement of structure should be done both as a means to screen views of the transmission line and to minimize the need for vegetation clearing.

3.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

3.1 Cleanup

3.1.1 All litter resulting from construction is to be removed, to the satisfaction of the landowner, from the right-of-way and along access roads leading to the right-of-way. Such litter shall be legally disposed of as soon as possible, but in no case later than within 60 days of completion of wire clipping. If requested by the landowner, the OWNER shall provide for removal of any additional construction-related debris discovered after this initial cleanup.

3.1.2 Insofar as practical, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, stockpiles or excess or waste materials, or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical, in consultation with the landowner.

3.2 Restoration, Reclamation, and Revegetation

3.2.1 Restoration, reclamation, and revegetation of the right-of-way, access roads, crane pads, splicing or stringing sites, borrow sites, gravel, fill, stone, or aggregate excavation, or any other disturbance shall be in accordance with the Reclamation and Revegetation Plan. The OWNER may choose to develop this plan in consultation with appropriate land management agencies as part of easement negotiations. In this case, the OWNER shall provide written documentation of consultation with those agencies and a copy of the agreed-to plan.

3.2.2 After construction is complete, and in cooperation with the landowner, temporary roads shall be closed.

3.2.3 In agricultural areas where soil has been compacted by movement of construction equipment, the OWNER shall direct the CONTRACTOR to rip the soil deep enough to restore productivity, or if complete restoration is not possible, the OWNER shall compensate the landowner for lost productivity.

3.2.4 Earth next to access roads that cross streams shall be replaced at slopes less than the normal angle of repose for the soil type involved.

3.2.5 All drainage channels shall be restored to a gradient and width which will prevent accelerated gully erosion.

3.2.6 Drive-through dips, open-top box culverts, waterbars, or cross drains shall be added to roads at the proper spacing and angle as necessary to prevent erosion.

3.2.7 Interrupted drainage systems shall be restored.

3.2.8 Seeding prescriptions to be used in revegetation, requirements for hydroseeding, fertilizing, and mulching, as jointly determined by representatives of the OWNER, DNRC, DSL, and other involved state and federal agencies, are specified in Addendum L.

3.2.9 Piling and windrowing of material for burning shall use methods that will prevent significant amounts of soil from being included in the material to be burned and minimize destruction of ground cover. Non-mechanized methods are

recommended if necessary to minimize soil erosion and vegetation disturbance. Piles shall be located so as to minimize danger to timber and damage to ground cover when burned.

3.2.10 During restoration in areas where topsoil has been stockpiled, the site will be graded to near natural contours and the topsoil will be replaced on the surface.

3.2.11 Excavated material not suitable or required for backfill shall be evenly filled back onto the cleared area prior to spreading any stockpiled soil. Large rocks and boulders uncovered during excavation and not buried in the backfill will be disposed of as approved by the STATE INSPECTOR and/or the landowner.

3.2.12 Application rates and timing of seeds and fertilizer, and purity and germination rated of seed mixtures, shall be as determined in consultation with the DNRC and U S. Forest Service. Reseeding shall be done at the first appropriate opportunity after construction ends.

3.2.13 Where appropriate, hydroseeding, drilling, or other appropriate methods shall be used to aid revegetation. Mulching with straw, wood chips, or other means shall be used where necessary.

3.2.14 All temporary roads shall be obliterated and reclaimed (with the concurrence of the landowner). All temporary roadways shall be graded and scarified to permit the growth of vegetation and to discourage traffic. Permanent unsurfaced roadbeds not open to public use will be revegetated as soon after use as possible unless specified otherwise by the landowner.

4.0 OPERATION AND MAINTENANCE

4.1 Right-of-Way Management and Road Maintenance

4.1.1 Maintenance of the right-of-way and permanent access roads shall provide for the protection of SENSITIVE AREAS identified prior to and during construction.

4.1.2 Vegetation that has been saved through the construction process and which does not pose a hazard or potential hazard to the powerline, particularly that of value to fish and wildlife, shall be allowed to grow on the right-of-way.

4.1.3 In areas other than cropland, vegetation cover shall be maintained in the areas immediately adjacent to transmission towers in cooperation with the landowner.

4.1.4 Grass cover, water bars, cross drains, and the proper slope shall be maintained on permanent access roads and service roads in order to prevent soil erosion.

4.2 Maintenance Inspection

4.2.1 The OWNER shall have responsibility to correct soil erosion or revegetation problems on the right-of-way or access roads as they become known. Appropriate corrective action will be taken where necessary. The OWNER may, through agreement with the landowner or managing agency, provide a mechanism to identify and correct such problems.

4.2.2 Operation and maintenance inspections using ground vehicles shall be timed so that routine maintenance will be done when access roads are firm, dry or frozen, wherever possible.

4.3 Correction of Landowner Problems

4.3.1 When the facility causes interference with radio, TV, or other stationery communication systems after the facility is energized, the OWNER will correct the interference with mechanical corrections to facility hardware, or antennas, or will install remote antennas or repeater stations, or will use other reasonable means to correct the problem.

4.3.2 The OWNER will respond to complaints of interference by investigating complaints to determine the origin of the interference. If the interference is not caused by the facility, the OWNER shall so inform the person bringing the complaint,. The OWNER shall provide the STATE INSPECTOR

with documentation of the evidence regarding the source of the interference if the person brings the complaint to the STATE INSPECTOR or the BOARD.

4.4 Herbicides and Weed Control

4.4.1 Weed control, including any application of herbicides in the right-of-way, will be in accordance with recommendations of the Montana Department of Agriculture, and in accordance with a right-of-way maintenance plan.

4.4.2 Herbicides will not be used in certain areas identified by DNRC, MDFWF, and DHES, or as requested by the landowner.

4.4.3 Proper herbicide application methods will be used to keep drift and nontarget damage to a minimum.

4.4.4 Herbicides must be applied according to label specifications and in accordance with 4.4.1. above. Only herbicides registered in compliance with applicable federal and state laws may be applied.

4.4.5 Herbicides shall not be sprayed during heavy rains or threat of heavy rains. Vegetation buffer zones shall be left along all identifiable stream channels. herbicides shall not be used in any public water supply watershed identified by the DHES.

4.4.6 In areas disturbed by transmission facilities, the OWNER will cooperate with landowners in control of noxious weeds as designed by the weed control board having jurisdiction in the county crossed by the line.

4.4.7 All applications of herbicides must be performed by a licensed applicator.

4.4.8 During the second and third growing seasons following the completion of restoration and reseeding, the OWNER and STATE INSPECTOR shall inspect the right-of-way and access roads for newly-established stands of noxious weeds. The county weed control supervisor shall be invited to attend this inspection In the event that stands of weeds are encountered, appropriate control measures shall be taken by the OWNER.

4.5 Monitoring

4.5.1 DNRC may continue to monitor operation and maintenance activities for the life of the project in order to ensure compliance with the specifications in this section.

4.5.2 The OWNER will be responsible to DNRC for the term of the RECLAMATION BOND. After this time the OWNER will report to individual landowners and managing agencies except as specified in conditions to the certificate.